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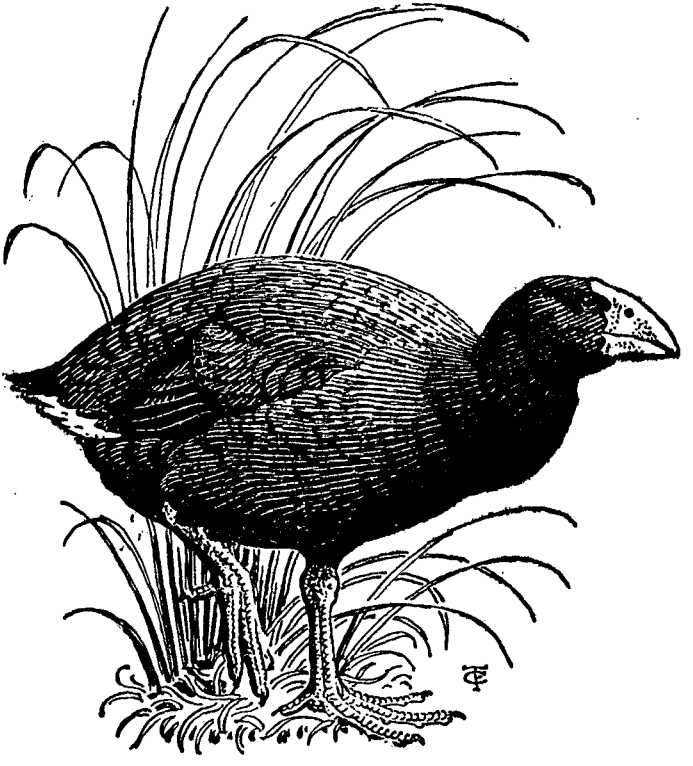

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SOME OBSERVATIONS OF FEEDING STATIONS, FOOD AND BEHAVIOUR OF THE NORTH ISLAND SADDLEBACK ON HEN ISLAND IN JANUARY

By D. V. MERTON
Wildlife Branch, Dept. of Internal Affairs, Auckland

INTRODUCTION

A study of Saddleback *(Philesturns carunculatus rufusater)* on Hen Island begun in August 1963 (see studies by Atkinson, Blackburn, Kendrick and Skegg 1964) was continued in January 1964, in conjunction with the Wildlife Branch, Department of Internal Affairs, Saddleback trapping operations mentioned elsewhere (Merton 1965).

This paper records the observations made by the team of Ornithological Society members that assisted the Wildlife Branch to trap and transfer Saddlebacks, i.e. A. and G. Baskett, D. J. Campbell, D. R. Ellis, J. Ewen, G. and M. J. Hogg, J. L. Kendrick, J. Kerr, N. J. Ledgard, M. G. MacDonald, G. J. H. Moon, L. C. Shailer, R. H. Sibson, P. D. G. Skegg, D. M. Walters and the writer, who led the party. It is the result of a team effort by all concerned.

FEEDING STATIONS

A total of 88 feeding observations was made, 42 of which were timed and involved 374 minutes (see Tables I and II). These observations are open to the criticism that, due to disturbance created by trapping, birds may not have been behaving normally. However, care was taken to make notes only of birds which were apparently unperturbed and some hundreds of yards from trapping sites. In timed observations some bias in favour of birds feeding on or near the ground may have occurred, as these are presumably more easily observed. We consider it worthwhile to publish this data since at present little information is available on the January feeding behaviour of the species. Further study will verify the validity of these observations.

TABLE I — FEEDING STATIONS OF THE NORTH ISLAND SADDLEBACK ON HEN ISLAND — JANUARY 1964

Feeding Stations	No. of Observations	% of Total
Aerial Feeding 3+ feet above ground	0	0
Aerial feeding within 3 feet of ground	0	0
Canopy foliage (excluding tufted crowns)	23	26
Foliage of cabbage tree, nikau, astelias, etc.	3	4
Understorey foliage	4	5
Dead foliage	4	5
Fruit	13	14
Bark of upper branches, and twigs	16	18
Branch axils	2	2
Dead branches	2	2
Holes	1	1
Boles	4	5
Ground	16	18
TOTAL	88	100

A posible change of feeding stations seemed to have occurred since August, with 26% of observations being in canopy foliage (9% in August). Birds observed feeding on the ground, however, remained at this feeding station for much longer periods than in August. Of timed observations, 47% of the time was spent on the ground (33% in August), 17% in canopy foliage (24% in August) and 36% on boles and branches (43% in August).

TABLE II — TIMES SPENT BY SADDLEBACKS IN THREE GROUPS OF FEEDING STATIONS ON HEN ISLAND — JANUARY 1964

Feeding Stations	No. of birds observed	Total time of observations (Minutes)	% of Total
In foliage	15	63	17
Branches/boles	15	134	36
On ground	12	177	47
TOTAL	42	374	100

FOODS

The apparent movement to canopy foliage could possibly be explained by the abundance of fruits and berries at this station during January, which were not available in August. Table III shows that a large proportion of berries was taken in January. There is no reason to suppose that disturbance of birds would have affected foods taken.

Twenty observations were made in which food was identified.

TABLE III — FOODS OF SADDLEBACKS ON HEN ISLAND — JANUARY 1964

Food	No. of observations
Caterpillars	8
Spiders and centipedes	2
Wetas	1
Berries of five finger *(Neopanax arboreum)*	4
Berries of karaka *(Corynocarpus laevigata)*	2
Green berries of taupata *(Coprosma repens)*	1
Berries of *Coprosma macrocarpa*	1
Fruit of Hangehange *(Geniostoma ligustrifolium)*	1
TOTAL	20

One female Saddleback was seen on 31/1/64 by D.V.M. in sustained level flight for a distance of approximately twenty feet, as it flew from a karaka tree to a fivefinger carrying a ripe karaka berry in its bill. It perched on a limb fifteen feet above the observer and at once took the berry in the claws of one foot, "parrot fashion." Pieces of flesh were then torn off the berry as it was held firmly against the limb with one foot. After about thirty seconds of feeding in this manner, the stone, with fragments of flesh still attached, was dropped to the ground. A second feeding observation on ripe karaka berries recorded by M.J.H. was of a similar pattern.

As in August, litter invertebrate fauna was abundant and varied, but an examination of canopy branches and foliage by D.J.C. revealed that scale insects were now virtually absent, as were their egg cases,

found previously under bark. Although cockroaches were still numerous in a variety of situations, in particular under kanuka bark, their eggs were no longer found under bark as they had been in August.

DRINKING AND BATHING

Five drinking observations were obtained, four at the camp water hole (L.C.S.) and the other, after a shower on 11/1/64 when a bird was seen to turn almost upside down to reach drops of water on the undersides of *Coprosma macrocarpa* leaves (D.V.M.). The observations made at the water hole were all obtained on 8/1/64, an unusually warm day, when L.C.S. spent from 11 a.m. to 4 p.m. in a hide photographing birds seeking water. This water-hole was constantly attended by numbers of birds of several species and was apparently the only source of fresh water in the area.

During this period four single Saddlebacks appeared and drank. It is not known whether these were different individuals or not. The first was present for about two minutes, only five seconds of which were actually spent in drinking. The remaining three birds were present for only a few seconds each, when they drank. Subsequent observers from this hide failed to obtain further Saddleback drinking records, although a large number of hours were involved. Considering the intensity of local trapping operations this is not surprising.

Although many astelias and collospermums were found to contain water, no drinking observations were obtained from them. The importance of such epiphytes in providing water for birds during dry periods is not known.

[G. J. H. Moon

I — Male North Island Saddleback bathing on Hen Island.

Mr. G. J. H. Moon, who was present on Hen Island again for nine days during late December 1964, has kindly made available his notes on drinking and bathing of Saddlebacks. Over six days he spent a total of thirty hours in a hide near the camp water-hole but his observations are incomplete in that they cover periods from mid-day until early evening only, when the water-hole was in direct sunlight.

Saddlebacks were seen drinking on six occasions averaging about once every four hours during the heat of the day. Drinking usually lasted for about ten seconds but on two occasions, when birds remained to bathe, they were present for forty seconds. Both the acts of drinking and bathing were performed in a similar manner to that of most other passerines, in particular Tui *(Prosthemadura novaeseelandiae),* with much gusto and nervous energy expended. In the case of drinking the bill was plunged into the water and then elevated briefly to aid swallowing. When bathing the birds would squat down for brief periods in shallow water while they dipped their heads under to throw water over their backs and flapped their wings to send up showers of spray. Following this, the now bedraggled-looking Saddlebacks would adapt a more upright stance to assist drainage of their apparently sodden plumage. A hurried fluffing of the plumage completed the toilet, after which birds would immediately return to cover without preening.

COURTSHIP-FEEDING AND FANTAIL ASSOCIATION

Of the 88 recorded observations, 7 involved courtship feeding of the female by the male, and on 11 occasions Fantails *(R. fuliginosa placabilis)* were associating with feeding Saddlebacks. Of the latter observations, one was of 20 minutes duration, when a Fantail was in continuous attendance on a pair feeding on the ground (L.C.S.). A second was of a Fantail seen following a pair for 150 yards (G.J.H.M.). Both courtship feeding and Fantails asociating with Saddlebacks were in evidence during the Hen Island expedition of August 1963 and have been discused at length by Blackburn (1964).

CONCLUSIONS

1. In January most Saddleback family parties and pairs without young adhered strictly to a well defined territory which they defended.
2. Courtship feeding of the female by the male took place in January, although probably less frequently than it did in August prior to nesting.
3. In January, as in August, insects comprised the bulk of the diet, although some birds were found to feed to a greater extent on the wealth of berries available to them during summer.

ACKNOWLEDGEMENTS

We are greatly appreciative of Mr. I. A. E. Atkinson's encouragement and guidance with this study and for criticism of this paper.

Our thanks are again due to the Navy for their assistance with transport.

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FEEDING STATIONS AND FOOD OF NORTH ISLAND SADDLEBACK IN MAY

By I. A. E. ATKINSON
Botany Division, Department of Scientific and Industrial Research, Lower Hutt

INTRODUCTION

Further observations of the feeding stations and foods of North Island Saddleback *(Philesturnus carunculatus rufusater)* were made on Hen Island by a combined Wildlife Branch - O.S.N.Z. - D.S.I.R. party between the 11th and 21st May, 1965. The party, led by Mr. D. V. Merton, included Pamela J. Atkinson, Angela M. Campbell, Messrs. K. C. Atkinson, D. J. Campbell, A. M. C. Davis, D. R. Ellis, J. L. Kendrick, N. J. Ledgard, R. H. Sibson and the writer. All members contributed observations so that this paper is again the result of a team effort. The method of recording is similar to that used previously (Atkinson, in press). The results can be compared with earlier studies on Hen Island made in August and January (Atkinson 1964, Merton 1966).

FOODS

As was found by previous parties, the bulk of food taken by Saddlebacks appears to be insects. In 42 cases it was possible to be reasonably certain of the type of food taken (Table 1).

TABLE 1—FOODS OF SADDLEBACK ON HEN ISLAND: MAY, 1965

Food	No. of observations
Caterpillars, beetle larvae	10
Cocoons of case moth	3
Flower buds of fivefinger *(Neopanax arboreum)*	3
Fruit of fivefinger *(Neopanax arboreum)*	8
Fruit of houpara *(Pseudopanax lessonii)*	1
Fruit of pate *(Schefflera digitata)*	4
Berries of inkweed *(Phytolacca octandra)*	1
Berries of nightshade *(Solanum nodiflorum)*	1
Seeds of rewarewa *(Knightia excelsa)*	1
Nectar (?) of puriri *(Vitex lucens)*	8
Water	2
Total	42

Saddlebacks feeding at puriri flowers visited each flower for a few seconds and probed into the flower centre with the bill, probably, but not certainly, taking nectar. The most abundant source of nectar on the island during May appeared to be kohekohe, the flowers of which were being visited frequently by Bellbirds and Tuis, but apparently not by Saddlebacks.

Following two or three days without rain, J.L.K. saw a Saddleback drinking droplets of water hanging from ripe fivefinger berries. However, during a wet spell, K.C.A. saw a bird drink twice from the bowled basal portion of a live karaka leaf; each time the head was first lowered and then thrown right back.

FEEDING STATIONS

Most of the observations could be classified according to the type of forest in which they occurred (Table 2). More than half were of birds feeding within a quarter of a mile of the camp-site at Dragon's Mouth Cove. The forest types in this area are pohutukawa, kanuka, pohutukawa-puriri and taraire-tawa. The figures suggest that pohutukawa and kanuka forests were preferred to the other forest types. Further evidence that this is the case is given by Atkinson and Campbell (in press).

TABLE 2 — OBSERVATIONS OF SADDLEBACK FEEDING IN RELATION TO VEGETATION TYPES ON HEN ISLAND: MAY, 1965

Type of Vegetation	No. of times when feeding observations were recorded
Kanuka forest	15
Puriri-kanuka forest	2
Tawa-kanuka forest	1
Puriri-taraire-tawa forest	5
Taraire-tawa forest	2
Pohutukawa-puriri forest	2
Pohutukawa coastal forest	14
Other types of vegetation	2
Total	43

A summary of the recorded feeding stations is given in Table 3.

TABLE 3 — FEEDING STATIONS OF THE SADDLEBACK ON HEN ISLAND: MAY, 1965

Feeding Stations	No. of observations	% of Total
Aerial feeding	0	0
Live foliage of vegetation canopy (excluding tufted crowns)	30	12
Live foliage of cabbage tree and epiphytic collospermum	4	1
Live foliage of lower branches and understorey	8	3
Dead foliage and vine stems	9	4
Flowers	9	4
Flower buds	4	1
Fruit	19	8
Twigs (living and dead)	23	10
Bark of branches and limbs	59	24
Branch axils, fissures, holes	16	7
Dead branches and limbs	16	7
Bark of trunks	9	4
Ground	36	15
Total	242	100

There was nothing to suggest that the birds used different feeding stations at different times of the day, so far as could be detected from fragmentary observations of many birds.

In many of the foliage observations the birds appeared to be taking insects, sometimes by hanging upside down and searching the undersides of leaves. D.J.C. saw one bird use its bill in the manner of a paper knife while removing a caterpillar from a rolled leaf of *Coprosma macrocarpa*. N.J.L. saw a bird hold a rolled dead leaf in its foot while the bill probed inside. Three or more observations of feeding among foliage were made with each of the following species:— cabbage tree (*Cordyline australis*), kanuka (*Leptospermum ericoides*), kawakawa (*Macropiper excelsum*), mapou (*Myrsine australis*), pohutukawa (*Metrosideros excelsa*), and taraire (*Beilschmiedia taraire*). Caterpillars were moderately abundant in the upper foliage of kanuka at this time of the year.

Of the birds feeding in holes and fissures, and under bark of branches, limbs or trunks, five or more were recorded in each of the following species:— *Coprosma macrocarpa*, fivefinger (*Neopanax arboreum*), kanuka, mahoe (*Melicytus ramiflorus*), mapou, pohutukawa, puriri (*Vitex lucens*), and taraire. Several birds were seen using their upper mandibles as levers. One bird picked up a piece of bark with its foot and examined it (D.J.C.; A.M.C.) and I saw a bird use its foot to lever out a piece of bark from a kanuka trunk.

Twenty-five of the 36 birds feeding on the ground were in litter and, of the 21 cases where the forest type was determined, 13 were in pohutukawa coastal forest, i.e. in litter consisting of a varying mixture of pohutukawa, karaka (*Corynocarpus laevigata*), coprosma, whau (*Entelea arborescens*), mahoe, kawakawa and sometimes pukanui (*Meryta sinclairii*) leaves. A.M.C. saw a bird flicking aside leaves with its bill until a patch of bare soil was exposed, some 3 in. in diameter, and A.M.C.D. noted a bird probing into the soil. No birds were seen feeding in the litter of the mature taraire forest.

Five other observations of ground feeding were of birds feeding on logs. N.J.L. saw a male bird hack systematically through a 6 in. diameter rotten log, 12 in. long, until it was reduced to a heap of debris.

Table 4 summarises the results of the timed observations made of Saddleback feeding. Timed observations were begun only after the birds appeared to be taking little notice of the observer and the times recorded are approximate. Two birds timed at the same station were considered as two separate observations and the times for each bird added.

TABLE 4 — TIMES SPENT BY SADDLEBACKS IN THREE GROUPS OF FEEDING STATIONS ON HEN ISLAND: MAY, 1965

Feeding Stations	No. of birds observed	Total time of observations (min.)	Percentage of total
Among upper foliage, fruit and flowers	20	137	34
Among lower foliage and bark of branches, limbs, etc.	23	137	34
On ground	11	124	32
Total	54	398	100

DISCUSSION AND SUGGESTIONS FOR FURTHER STUDIES

The observations of Saddleback feeding stations made on Hen Island by the 1963, 64 and 65 parties are compared in Table 5.

TABLE 5 — COMPARISON OF SADDLEBACK FEEDING STATIONS: 1963 - 65

Feeding Stations	% of Observations May 1965 (Data from present paper)	August 1963 (Data from Atkinson 1964)	January 1964 (Data from Merton 1966)
Canopy foliage	13	17	30
Understorey foliage	3	6	5
Dead foliage	4	8	5
Fruit	8	1	14
Branches, limbs, twigs	34	29	18
Branch axils, holes, dead branches	14	4	5
Trunks	4	11	5
Ground	15	21	18
Other stations	5	3	0
Total	100	100	100
	242 observations in 10 days	205 observations in 10 days	88 observations in 28 days

The study of August 1963 did not separate twigs from branches, nor branch axils and holes from dead branches. It would seem worthwhile to do this in future so that food sources can be localised (see Atkinson 1966).

These figures suggest trends in the use of several groups of feeding stations that may be related to seasonal variation in the distribution of insects. However, repeated observations at these and other times of the year will be necesary before definite conclusions are possible.

What is clear is that the North Island Saddleback uses several feeding methods to eat a wide range of foods from a wide variety of feeding stations distributed through all levels in the forest. There is no clear indication of how food might limit the numbers of Saddlebacks on Hen Island or elsewhere but a few suggestions that may help to answer this question are as follows:—

1. Results to date have been based on fragmentary observations of many birds and much useful information can be collected in this way. It would be of value also, by colour-banding, to examine the daily pattern of feeding in particular pairs of birds. Measuring the proportion of day spent feeding could indicate the times of year when food is most scarce (see Gibb 1954).
2. We do not yet know the foods fed to nestlings; these may differ from those eaten by the adult. Use of an artificial nestling (see Betts 1954, 1956) could answer this question.
3. Judging by the number of instances (42 in May) when it was posible to identify the type of food taken, a party concentrating on this aspect could achieve valuable results.
4. Sampling for invertebrates. By sampling feeding stations that are visited frequently by Saddlebacks as well as sampling particular places in the litter, branches, or foliage where Saddlebacks have been seen feeding, it may be possible to understand why particular stations are visited more frequently at one time of the year than another.

ACKNOWLEDGEMENTS

I am indebted to Dr. J. A. Gibb, Mr. D. J. Campbell and Dr. E. J. Godley for helpful criticisms of the manuscript of this paper.

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SHORT NOTE

STRONG HOMING INSTINCT IN A SPOTLESS CRAKE

Near Pirongia, in the Te Awamutu district there are several swamps which contain Spotless Crakes *(P. tabuensis)*. One of these birds was caught and killed by a cat on a farm two miles south of Pirongia. This led to further inquiries being made and it was found that this small shy rail was quite common in a swamp on Mr. H. R. de Thierry's property. However, this swamp was shortly to be burned and cleared.

In order to try to save some of these birds from almost certain destruction, it was decided to catch as many of them as possible, band them, and then release them in a suitable swamp near the Hamilton Junior Naturalists' Club Lodge at Oparau. With the aid of a party from the Club, mist-nets were set up across the swamp and the vegetation systematically beaten towards the nets. Two birds were caught and, after banding, released. They were in excellent condition; and after being in captivity for only five hours, they immediately disappeared into cover. The date of this operation was 5/12/64.

On 22/1/65, about six weeks later, Mr. D. V. Merton, Wildlife Officer, Auckland, assisted with another netting operation in Mr. de Thierry's swamp. This time only one bird was captured; and to the amazement of all it was found to be banded and to be one of two birds previously caught. By the shortest route, it had travelled at least 15 miles from the point of release back to precisely the same spot where it was first captured and now had been recaptured.

Reports of the Spotless Crake in previous isues of Notornis indicated that the bird was a weak flier, as flights were of short duration before the bird dropped into cover. Oliver quotes R. S. Bell as having seen a longest flight of nine and a half yards. Buddle records a flight of twenty yards.

It is hard to imagine that this bird would have managed to return in such a short time across country abounding in various predators, and including in the terrain the bush covered range of Mt. Pirongia, unless capable of sustained flight. Perhaps this species flies more during night time.

When the bird was released on the second occasion it flew and glided about seventy yards, down into a valley. When last sighted it was still flying strongly.

— JOHN KENDRICK

IDENTIFICATION OF FEEDING STATIONS OF FOREST BIRDS IN NEW ZEALAND

By I. A. E. ATKINSON
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INTRODUCTION

The food and feeding behaviour of most New Zealand forest birds, both native and introduced, are not adequately known. Apart from its intrinsic interest, this information is needed to understand factors controlling bird numbers. In the case of rare birds, knowledge of their food is essential when control of the habitat is planned in order to maintain or increase their numbers. Analyses of crop contents are usually not possible; analyses of droppings are difficult, and because of breakdown within the alimentary canal, many foods taken leave no trace. During spring the food given to nestlings can sometimes be observed, although this may differ from that of the adult. For most of the year it is usually difficult to see what food is taken, especially in tall forest.

Another approach to the study of feeding habits in forest birds is to record the birds' feeding methods and the precise position within the community where feeding is taking place, i.e. *the feeding station*. Numerous records together give a picture of the frequency with which each station and feeding method is used. An example of this approach applied to pine forest in New Zealand has been published by Gibb (1961). Subsequent sampling at feeding stations can establish what particular foods are available, though not necessarily which are being eaten.

The method described here was developed particularly for studying Saddlebacks on Hen Island. However, the study by Merton and my own obseravtions show that the method can sometimes be useful for other birds in New Zealand forests. The main requirement is a systematic procedure for distinguishing feeding stations quickly and recording the position of each station within the forest. Feeding methods and errors that can be avoided are also discussed.

FEEDING LEVELS

Some species feed consistently more at one height than another. For example Hartley (1935), in his study of English titmice, found that each species had a characteristic height distribution of foraging activities with preferences for certain species of trees and parts of trees. The height distribution of some species varied seasonally.

The height at which a single bird is feeding can be estimated. If a bird is moving continuously or if a flock is encountered, it is easier to record the range of heights or vegetation storey in which feeding is taking place. The following scheme is suggested (Fig. 1):—

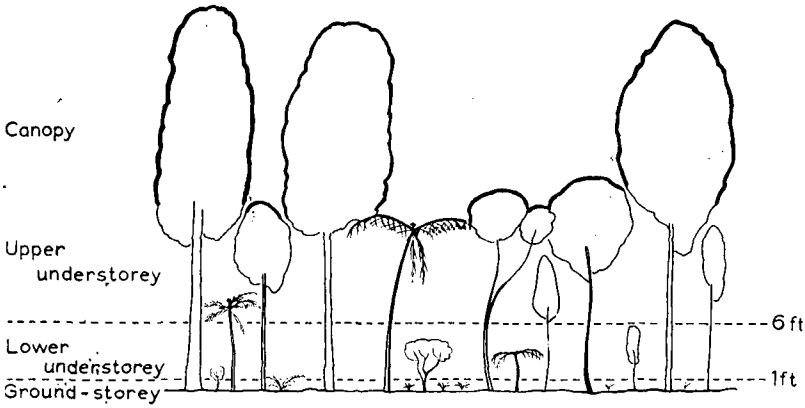

Fig. 1 — Division of forest storeys for recording positions of feeding stations. Note that in this diagram tree ferns are present in the canopy, upper and lower understorey.

1. *Canopy*. The uppermost storey of tree crowns, unshaded by other crowns.
2. *Upper understorey*. A storey of plant crowns (<6 ft.) shaded by the canopy.
3. *Lower understorey*. A storey of shrubs, tree ferns, etc., from 1 - 6 ft. in height, shaded by the canopy.
4. *Ground-storey*. The lowermost storey consisting of plants with growing points situated less than 1 ft. above the ground, together with the litter.

The 6 ft. level separating upper and lower understoreys in the above scheme is an arbitrary height chosen because it is the approximate upper limit of browsing reached by animals such as deer and goats.

It is important to make a clear distinction between *canopy*, which refers to the uppermost storey of vegetation, and *crown*, which refers to the upper part of any plant delineated by the periphery of its foliage. It should be noted also that a bird catching insects in the air at, for example, a height of 5 ft., is feeding in the lower understorey.

FEEDING STATIONS

Notes should be made of the type of forest with the height range of its canopy, e.g. rimu-rata/tawa forest (70-90ft.). Where necessary the kind of place can also be recorded, e.g. streambank, canopy gap caused by fallen tree. For some birds the time of day when feeding occurs may be important, because they change their feeding stations during the course of the day.

The main categories of feeding stations available to forest birds are listed in Table 1 and illustrated in Fig. 2. For study of some birds these categories may need to be subdivided or new ones added. With the exception of ground stations, the cateogries listed may be recorded within any of the vegetation storeys outlined above.

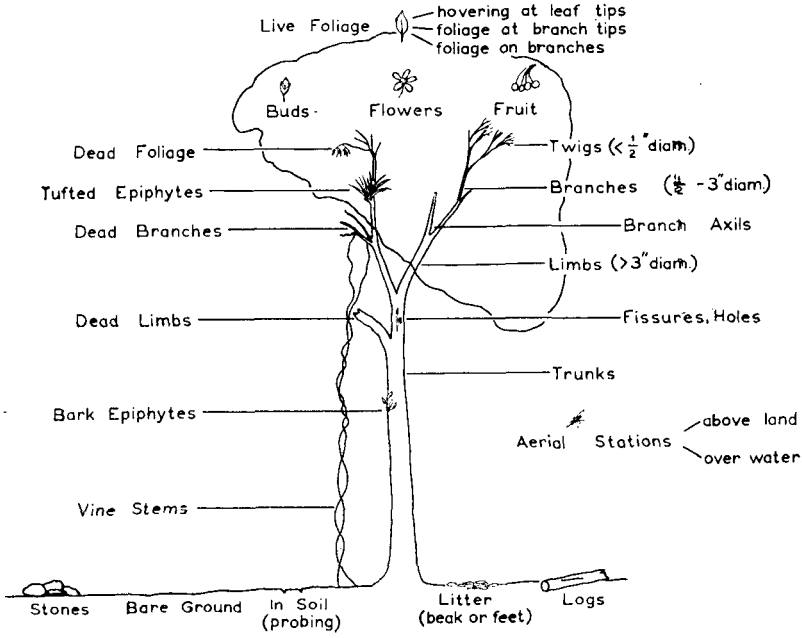

Fig. 2 — Feeding Stations

TABLE 1 — Feeding Stations for Birds in Forest

Aerial stations:	over land
	over water
Live foliage:	hovering at leaf tips
	foliage at branch tips
	foliage on branches
Dead foliage	
Buds	
Flowers	
Fruit	
Twigs (<½ in. diam.)	
Branches (½ - 3 in. diam.)	
Limbs (<3 in. diam.)	
Trunks	
Dead twigs and branches	
Dead limbs and trunks	
Branch axils	
Fissures and holes	
Tufted epiphytes	
Bark epiphytes	
Stems of vines and climbers	
Stones	
Bare ground: on surface	
In soil: probing	
Litter: beak or feet	
Logs	

Tufted epiphytes include astelias, collospermums and some of the larger ferns such as *Asplenium falcatum*. Typical bark epiphytes are filmy ferns (*Hymenophyllum* spp.). The size ranges of twigs, branches, etc., follow those used by Gibb (1954) in a paper on the feeding ecology of English tits that covers several aspects of feeding behaviour not dealt with here.

The growth form of the plant in which feeding is taking place is recorded, e.g. tree, shrub, sapling, tree fern, palm, climber. Whenever possible the plant species is identified; this information can tell much about food sources and other features of the bird's habitat.

In identifying the feeding station it is sometimes difficult to distinguish living from dead branches and limbs, especially when a bird is changing its station frequently. Nevertheless, stations should be identified as specifically as possible.

Ideally the observer would like to record the proportion of time a bird spends searching for food at each station but usually only isolated observations are possible. When a bird is watched for a period of time the feeding station can be recorded at regular intervals of $\frac{1}{2}$ or 1 minute. By staggering the recording times, the feeding of two or three birds can sometimes be followed simultaneously. With a flock, only a generalised statement of the feeding stations may be possible.

On occasions the food taken will be seen. The importance of trying to see exactly what food is taken rather than surmising cannot be too strongly emphasised. For example a White-eye visits a flower cluster and plunges its head into the centre of a flower. It may be drinking nectar or it may be searching for insects but even with binoculars it is difficult to be certain.

Some feeding stations are used as sources of water. For example, Mr. J. L. Kendrick (pers. comm.) saw a Bush Pigeon drinking from the leaf bases of epiphytic collospermums, even though a stream was flowing close by. Hollows in the forks of trees and rain drops on leaves are also used as sources of water by birds.

FEEDING METHODS

Careful notes should be taken of the exact method of feeding as different species are adapted to take different foods from the same feeding station. Gibb (1961) in his pine forest study, found Whiteheads, White-eyes and Grey Warblers all taking food from live pine needles. His analysis showed that Whiteheads fed mostly on stouter parts of the trees, whereas White-eyes fed generally farther out towards the tips of the foliage. Grey Warblers specialised in taking food from the tips of the foliage by hovering, and seldom fed on the stouter branches.

Pied Tits and Robins both take food from the ground, but whereas the Pied Tit watches the ground surface for any moving insects from a convenient perch, the Robin works on the ground amongst the litter. Other species probe into the litter with the bill.

SOURCES OF ERROR

Although I do not wish to convey the impression that observing feeding stations of birds has insuperable difficulties, there are sources of error that can be minimised. An observer on the ground is in a poor position to see what is going on in the canopy of a tall forest. His observations of the feeding activity of any particular bird are likely to be biassed towards stations at the lower levels where visibility is better.

This error can be reduced by choosing observation points on sloping ground that allow a view into the canopy, or by climbing trees. Such error can possibly not be eliminated but it must always be remembered in interpreting the feeding pattern of a species. A second source of error occurs when a bird feeding at a lower level is frightened by the approaching observer to a higher level where it may be recorded as feeding. Patience and intimate knowledge of the bird's habits will enable this error to be reduced to a minimum.

Little is known concerning the extent to which a bird may change its feeding stations during the course of a day. This possibility should be kept in mind when making comparisons of the feeding stations of different birds. Again, the seasonal variation in pattern of feeding behaviour should be known, before comparing feeding stations of different species at different times of the year.

DISCUSSION

The methods of observation discussed in this paper can be applied to both native and exotic forests. It is not possible to make any rules concerning the number of observations necessary. All records can be valuable. However, when two species are apparently using the same source of food, hundreds of observations may be needed to establish whether this is in fact the case. It is clear that teams of observers all recording their observations in a systematic manner can make more rapid progress than single individuals (see team studies published by Atkinson 1964 and Merton 1966). It is strongly recommended that each individual develop his own shorthand to increase the number of records he can make.

Example: 10/1/63 Ohakune mountain road, 3000'. Red beech-silver beech forest (80 - 120').

0900 Sun Kaka C 70/90 nf d. limb, hang, tear, bark, beak.

At 9 a.m. in sunny weather, a kaka seen in the canopy, 70 ft. up a 90 ft. high red beech *(Nothofagus fusca)* on a dead limb, hanging upside down and tearing at the bark with its beak.

Opportunities for both individuals and teams to make significant contributions to our understanding of forest birds in New Zealand are numerous. Two interesting questions concern the proportion of day that a particular species spends in feeding and the reasons for seasonal changes in feeding behaviour. A closely related question concerns competition for food between species. To what extent does the food taken by the introduced Blackbird and Chaffinch, both widely distributed through New Zealand forests, overlap with that of native birds? To what exent does the introduced bush rat *(Rattus rattus)* compete with Bush-pigeons for food? Do the foods of Pigeon and Kokako overlap and how are these birds affected by opossums eating young shoots or fruit?

As detailed knowledge of the feeding habits of forest birds increases it will be possible to plan surveys of the invertebrate and plant foods that are available in a forest. Study of the factors regulating the quantity of these foods will pose many problems. The regulation by man of this food supply, together with other factors of the habitat in order to maintain or increase the numbers of birds in a particular area of vegetation is an objective that even though distant, can be kept constantly in view.

SUMMARY

The points discussed are summarised below as a check-list of observations for recording the feeding habits of forest birds.

Check-list of observations for feeding habits

1. Date
2. Locality and altitude
3. Time of day and weather
4. Bird species
5. Type of forest and height range of canopy
6. Kind of place (where necessary)
7. Feeding level: height (when possible) and forest storey in which feeding occurs (see Fig. 1)
8. Feeding station: type of station (see Fig. 2)
   plant species and growth form
9. Method of feeding
10. Notes on possible sources of error

ACKNOWLEDGEMENTS

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SHORT NOTE

A BREEDING COLONY OF GREY-FACED PETRELS IN TARANAKI

On 27/6/65, a party of Tarankai members was led by Mr. Gordon Johns of Pukearuhe to two areas about 30 miles north of New Plymouth where he had found "black" petrels in burrows.

The larger of these areas contained 28 burrows, several of which were occupied. From one, in which there was a pair of birds, one bird was extracted, photographed, and identified as *Pterodroma macroptera*. The nesting area is situated on the sloping top of a sandstone cliff about 50 ft. above the sea. The vegetative cover is mainly Taupata and Flax, with bare sand in the nest area. Elsewhere there is much bracken, marram and lupin cover. As there are many miles of similar broken coastline north of New Plymouth, it is probable that there will be further nesting sites.

On a subsequent visit by R. and M. Bysouth on the night of 28th August, one bird landed from at sea at dusk, and a cold egg was taken from a burrow.

— M. G. MACDONALD
D. G. MEDWAY

NOTES ON THE BIRDS OF THE RUAHINE RANGES

By C. N. CHALLIES
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INTRODUCTION

During the summer of 1961-62 the author took part in a vegetation condition survey of the Ruahine Ranges carried out by the Forest and Range Experiment Station of the Forest Research Institute, New Zealand Forest Service, and made use of the opportunity to record observations of the birds within this region. Between 14/11/61 and 16/1/62, the party, of which the author was a member, spent 40 field days in the northern half of the range, i.e. north of the Tukituki catchment, traversing all major catchments except the Ikawetea. Less time was spent in the southern Ruahines, two crossings of the range via the Pohangina, Tamaki and Makawakawa valleys being made in late January. In early February short visits were made to the Whanahuia Range and Mt. Wharite, and a further three days were spent in the Tukituki catchment. The Pourangaki and Oroua valleys, forming the mid-western drainage of the Ruahines, were not entered.

The author also kept bird records on earlier trips to the Ruahines. Eleven days were spent in the Ikawetea watershed and Ruahine Corner - Otupae Range area in February 1961 (1960-61 F.R.E.S. survey) and a further two days in April 1961.

The requirements of these surveys did not allow time to be assigned to bird observations, but throughout them the author kept daily lists of bird species seen and heard, these being as comprehensive as other work would permit. The daily lists included the number of observations of each species by vegetation classes, to determine habitat occupation and abundance. From these records the bird notes have been compiled.

AREA AND VEGETATION

The Ruahine mountain system (see figure 1) is a central section of the main mountain range of the North Island of New Zealand. The Manawatu Gorge marks its southern boundary with the Tararua Range and the Napier-Taihape (Inland Patea) road, passing throug a gap in the main range, separates the northern Ruahines from the Kaweka and Kaimanawa Ranges. An axial ridge extends the length of the mountain system and four major ridges radiate from it to the west. Much of these ridges exceeds 5,000 feet in altitude, but the southern third of the main range tapers to a narrower ridge of less than 4,000 feet.

The Ruahines are forested from the foot of the range, where the forest abuts on farm land, to the upper forest line. Mountain Beech *(Nothofagus solandri* var. *cliffortioides)* is the dominant forest species of the north and central range up to 4,000 - 4,500 feet, with some Red Beech *(Nothofagus fusca)* at lower altitudes. Above the forest line is a narrow scrub belt of leatherwood *(Olearia colensoi* and *Senecio elaeagnifolius),* especially in the central range, and of low-growing shrubs. Above this again tussock grassland extends to the

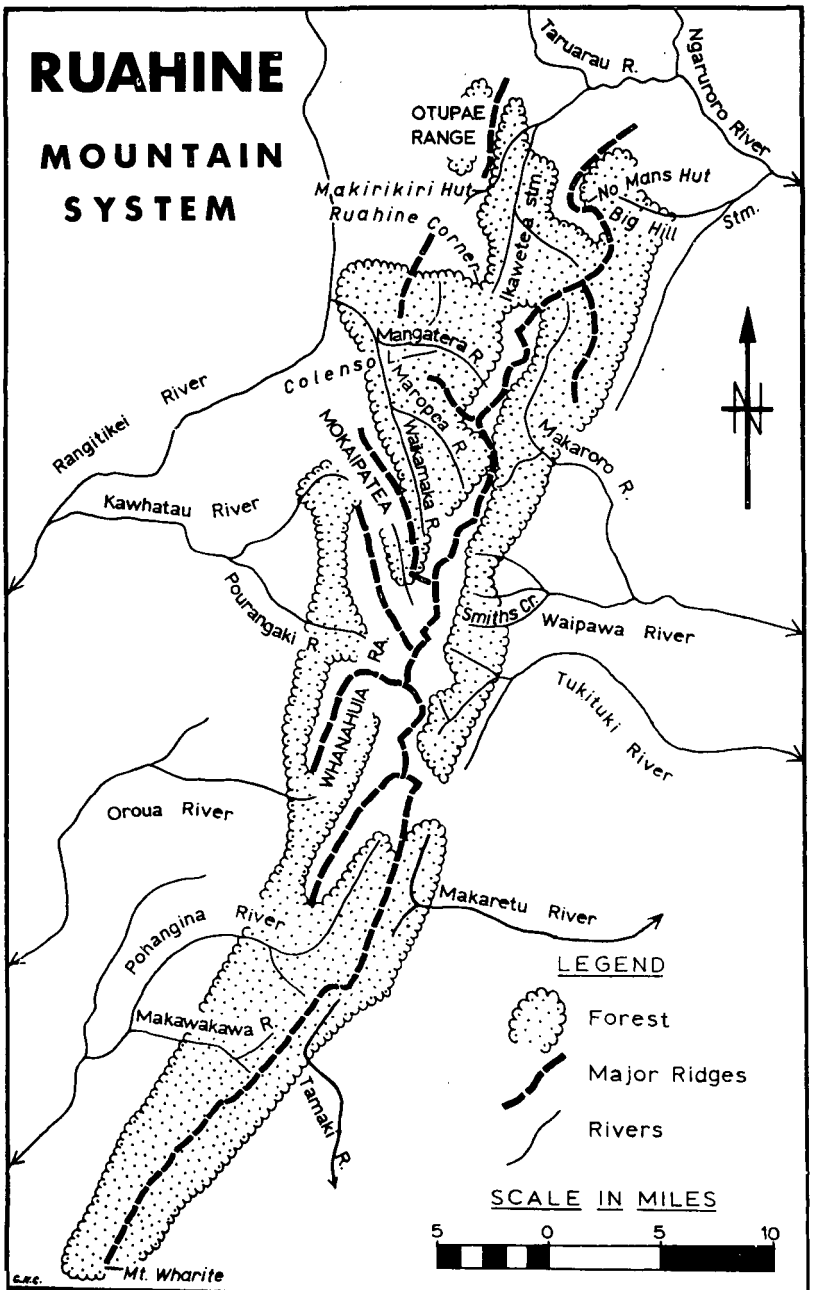

Fig. 1 — Map showing localities mentioned in the text.

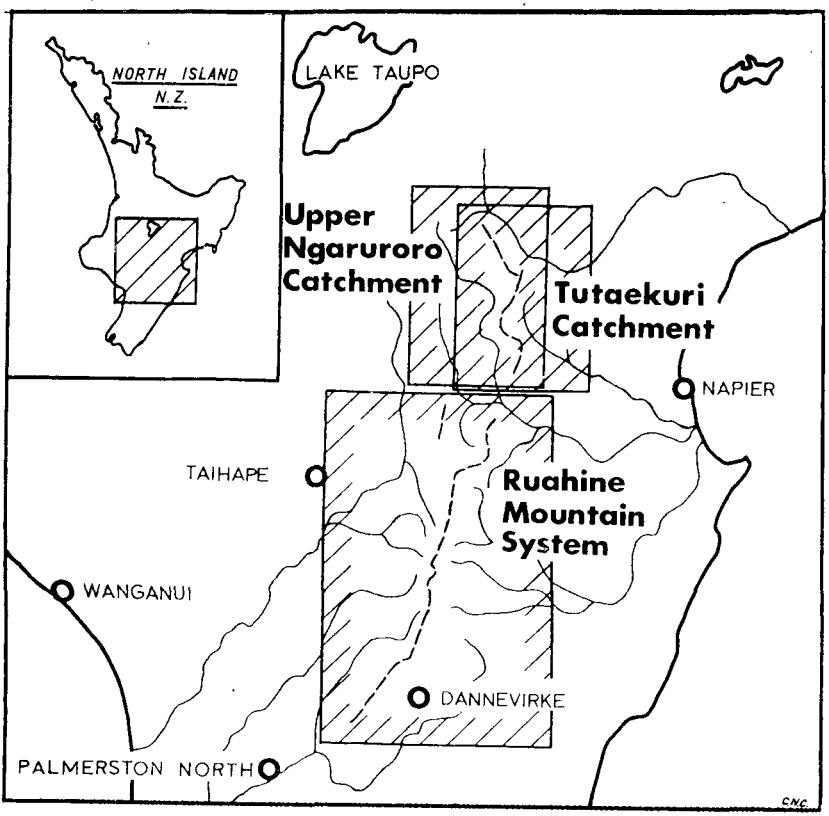

Fig. 2 — Map showing the location of the high-country areas detailed in the maps of Fordham (1961, p. 114) and Challies (1962, p. 123), and in figure 1 of this paper.

highest altitudes, being replaced by fell field on exposed sites. In the southern range, podocarp/hardwood forest occupies the lower slopes and kamahi *(Weinmannia racemosa)* is dominant on valley slopes up to 3,000 feet. Here it merges into leatherwood scrub, which persists to the crest of the range. Cedar *(Libocedrus* spp.) forest replaces mountain beech along the western flank of the range from Ruahine Corner to the Whanahuia. Traces of lowland podocarp forest remain on the flank of the range and a few pockets exist within the range, such as around Colenso Lake and near Makirikiri hut. In the north, tongues of manuka *(Leptospermum scoparium)* scrub and tussock extend into the Ruahines from the Blowhard and Ngamatea Plateaus.

RUAHINE BIRDS

Thirty-five species were observed within the Ruahine mountain system during the 1961-62 F.R.E.S. survey and two other species, the Greenfinch and Cirl Bunting, are recorded as present from earlier reports. Also included are two nil records, Kiwi and Robin. In the

following list, the notes on each species include its observed distribution, habitat, and abundance, along with any other relevant observations. Nomenclature and order of presentation follow the 1953 "Checklist of New Zealand Birds."

KIWI (*Apteryx* sp.)

No kiwis were observed. There appear to be no recent records of kiwis from the Ruahines (R.W., V.B., A.C., N.L.E., C.N.C.). Fleming (1941), with reference to *A. mantelli* (North Island Kiwi), states: "Once on Ruahines. No recent reports except on Whareti, over ten years ago" (i.e., before 1931).

BLACK SHAG *(Phalacrocorax carbo)*

A single bird was seen in flight along the Makaroro River near the mid-Makaroro hut in January 1962.

HERON (White-faced ?)

A greyish-blue heron was seen recently on the tussock tops near No Man's Hut (V.B.).

PARADISE DUCK *(Tadorna variegata)*

These birds were not observed within the mountain range but were seen on several occasions, usually alone or in pairs, near the forest edge in the Makaroro and Waipawa catchments. Larger numbers were seen in the wider, braided section of the Makaroro river bed, stretching a mile upstream from the Wakarara Mill; in November eight or more pairs, with at least two clutches of ducklings, were counted. A single bird was seen on the tussock grassland west of the Otupae Range.

GREY DUCK *(Anas superciliosa)*

This species was uncommon. Occasional single birds and pairs were seen along the larger rivers. Two were also seen to rise from a forest-enclosed pond of 10 by 30 yards in the lower Tukituki catchment. Lake Colenso, 4 acres in area and bounded by rushes and swampy ground, suggests desirable duck habitat, but three F.R.E.S. parties that visited it all reported an absence of waterfowl. The number of eels present may make these waters unsuitable.

BLUE DUCK *(Hymenolaimus malacorhynchos)*

Blue Ducks were present in all the western rivers from the Ikawetea southwards to the Kawhatau, sightings being especially numerous in the gorge of the Mangatera near Lake Colenso. Of the remaining western drainages, no records are known from the Oroua and Pourangaki, and no birds were observed in the Pohangina and Makawakawa Rivers. Occasional pairs and single birds were seen in the eastern rivers, namely the Makaroro, the Waipawa and Smiths Creek, but none in the Tukituki and Makaretu catchments (V.B., R.W.).

AUSTRALASIAN HARRIER *(Circus approximans)*

Harriers were regularly seen in flight over all subalpine tussock-grassland (tops) areas, and on farm land adjacent to the range.

Harriers probably feed to some extent on deer carcasses on the tops, although this was not observed. V.B. reports that they have often been seen perching close to carcasses.

NEW ZEALAND FALCON *(Falco novaeseelandiae)*

Scattered sightings of this species were made throughout the range, more birds being seen in the Makirikiri area than elsewhere, but

generally they were not common. They were heard or seen in flight over all vegetation types, but most commonly over sub-alpine vegetation and upper forest margins. One was seen viciously pursuing a Harrier at Armstrong Saddle in mid-December.

PHEASANT *(Phasianus colchicus)*

Occasionally birds were heard calling in the area between and including Ruahine Corner and the Makirikiri catchment. Single observations were made near Sentry Box hut and on lower Herricks Spur (A.C.). Pheasants are probably present throughout the area of manuka scrub and grassland adjacent to the Napier-Taihape road and as far south as Ruahine Corner on the west of the range and the Makaroro River on the east.

CALIFORNIAN QUAIL *(Lophortyx californica)*

Commonly seen along the Napier-Taihape road.

SOUTHERN BLACK-BACKED GULL *(Larus dominicanus)*

Single birds in flight were seen on several occasions in the Otupae range area. All appeared to be purposefully following the same route, some east to west, others west to east.

Occasional birds scavenge within the mountain range. A Black-backed Gull was observed feeding from a deer carcass on Mt. Paemutu at the head of Smith Creek (R.W.). Others birds have shown interest in working parties on the tops.

NEW ZEALAND PIGEON *(Hemiphaga novaeseelandiae)*

Pigeons were moderately common throughout the forested areas, being most numerous in the podocarp forests around Lake Colenso and the Makirikiri hut. They were usually seen in groups of from one to four birds flying over the lower and mid-valley slopes, but were occasionally seen up to the subalpine-scrub zone.

KAKA *(Nestor meridionalis)*

This species was not common. Birds were observed in the areas of podocarp forest near Lake Colenso and Makirikiri hut and a few in beech forest. One was also heard over kamahi forest in the mid-Pohangina valley.

PARAKEET *(Cyanoramphus sp.)*

Parakeets were recorded in small numbers from the forested areas north of and including the Tukituki catchment. They were not observed in the southern half of the range but are not necessarily absent.

No birds were identified to species. Other records suggest that both the Yellow-crowned *(C. auriceps)* and the Red-crowned *(C. novaezelandiae)* are present, but no indication of their relative numbers is given. In the adjacent Tutaekuri drainage, Caughley (1962, p. 138) identified 14 parakeets to species. All were Yellow-crowned and it is probable that this species also predominates in the Ruahines.

The New Zealand Parakeet (Red-crowned) has been reported from the Ruahines. N.L.E. states that his last certain identfication was from Colenso's Camp on Colenso's Spur in January 1948. Also, Wodzicki (1950) recorded Red-crowned Parakeets east of the Tukituki catchment: "Flock of four feeding on beech, Miln's Block, S.F. No. 34, near Ashley Clinton, Ruahines, 22/4/48." S.F. 34 is an error for Eastern Ruahine State Forest 24.

SHINING CUCKOO *(Chalcites lucidus)*

Shining Cuckoos were recorded in the forests of all catchments visited in November and December (the northern half of the range), where their calls were frequently heard. Only a few were heard calling in the areas traversed in January; they were probably present in moderate numbers but would be less conspicuous because of a decline in their calling.

LONG-TAILED CUCKOO *(Eudynamis taitensis)*

Heard calling throughout the duration of the survey but at no stage common. Scattered records of this species were made from forested areas throughout the range and occasionally from the sub-alpine belt up to 4,500 feet.

MOREPORK *(Ninox novaeseelandiae)*

This species was recorded in small numbers from all catchments visited, being present in beech, podocarp and kamahi forests. Moreporks were usually heard calling from the lower and mid-valley slopes; an exception was a bird that called loudly near an overnight camp on the upper forest line (4,650 feet) near Mt. Remutupo.

KINGFISHER *(Halcyon sancta)*

Kingfishers were not found far into the range; single birds were recorded in the "cut over" podocarp forest north of the Wakarara Mill and also in the lower reaches of the Makaroro River and Big Hill Stream.

RIFLEMAN *(Acanthisitta chloris)*

Riflemen were abundant throughout the range in beech, podocarp and kamahi forest up to the upper forest line. They were rarely seen outside forested areas.

SKYLARK *(Alauda arvensis)*

Larks were plentiful on lower altitude tussock grassland such as that in the north-western corner of the range and were also present on the open tops.

The skylark outnumbered the pipit on the taller *Chionochloa* tussock found at altitudes up to about 4,000 feet. On the sub-alpine areas of tussock, short grasses, herbs and bare ground the situation was reversed. The following figures from the author's daily records for 4/1/62 to 9/1/62 illustrate this: the ratio of skylarks to pipits seen between the Napier-Taihape road and the NW Otupae Range was 10:0, on the summit ridge of Otupae Range it was 3:9, and between upper Makirikiri and Ruahine Corner, 17:4.

FANTAIL *(Rhipidura fuliginosa)*

This species was present in moderate numbers in forest and scrub throughout the range. Birds were most often seen on the lower valley slopes and especially in the hardwood forest and scrub bordering streams. No individuals of the black phase were seen.

PIED TIT *(Petroica macrocephala toitoi)*

Present throughout the range in all forest types and in tall scrub. It was one of the three commonest native species of the forest, the others were the Riflemen and the Grey Warbler.

ROBIN *(Petroica australis)*

No robins were seen and there are no recent records of these birds in the Ruahines (R.W., V.B., A.C., N.L.E., C.N.C.). Fleming (1950) also noted the absence of Robins: "Major R. A. Wilson states that he has never seen robins in the Ruahine Range and there are no other reports." However, N.L.E. has seen this species within the range on two occasions — on Government Spur (Tukituki catchment) in December 1940 and at Shut Eye (northern Waipawa catchment) in December 1944.

WHITEHEAD *(Mohoua albicilla)*

Scattered observations were made of Whiteheads in mountain-beech forest and they were heard also in the forests of the Pohangina and Tamaki valleys. Several birds were seen also in the tall sub-alpine scrub of the Maropea catchment and above 4,000 feet in the mountain beech of the Otupae Range.

GREY WARBLER *(Gerygone igata)*

This species was abundant throughout the Ruahines. It was present in all forests and in sheltered areas of sub-alpine scrub, including that dominated by *Olearia colensoi*.

SONG THRUSH *(Turdus ericetorum)*

Thrushes were present in small numbers in all forested areas. Several were also seen in sub-alpine scrub. A nest containing three eggs was found in stunted (15ft. high) mountain beech at 4,250 feet on the Mokaipatea, 6/12/61.

BLACKBIRD *(Turdus merula)*

Blackbirds were abundant in all forest and scrub areas, especially in the more open vegetation. They were very common in sub-alpine scrub and in grassland where scrub species persisted. Blackbirds were four times as commonly seen as either Hedge Sparrows or Thrushes. Along with the Chaffinch the Blackbird was the commonest introduced species present.

HEDGE SPARROW *(Prunella modularis)*

Scattered observations of this species were made throughout the range, but generally Hedge Sparrows were not very common. They were found in both sub-alpine and lowland scrub and were occasionally seen in predominantly forested areas.

PIPIT *(Anthus novaeseelandiae)*

Present on the open tops as well as on low altitude tussock grasslands, e.g. north of Ruahine Corner. See notes for the Skylark.

BELLBIRD *(Anthornis melanura)*

Moderately common in forested areas throughout the range. One was seen in leatherwood scrub in the Tukituki catchment.

TUI *(Prosthemadera novaeseelandiae)*

This species was found mostly at lower altitudes, especially in podocarp forest. In these localised areas they were common, e.g. at lower Makaroro, around Lake Colenso, on the lower Mokaipatea and in the Makirikiri hut area. They were uncommon in beech forest.

WHITE-EYE *(Zosterops lateralis)*

Found in all forest types and in scrubland throughout the range. They were seen and heard only occasionally in November and December but became more noticeable during January and February when small noisy flocks were seen at all altitudes in forest and scrub and occasionally in flight over the open tops.

GREENFINCH *(Chloris chloris)*

Inclusion of this species is based on a single observation: in February 1961 two birds were seen among stunted mountain beech at 4,500 feet on Mt. Ikawetea.

LESSER REDPOLL *(Carduelis flammea)*

This species was present over tussock tops, in sub-alpine scrub, including areas dominated by *Olearia colensoi,* and in lower altitude manuka scrub. Flocks were seen from late November onwards, becoming larger and more numerous during January and February when they could be heard in flight over the tops even in wet and misty weather.

CHAFFINCH *(Fringilla coelebs)*

The commonest introduced species in the forests of the lower and mid-valley slopes. Here the birds were most often seen where the forest canopy was broken, for instance along stream-beds. They were seen also in manuka scrub and occasionally in sub-alpine scrub.

YELLOW-HAMMER *(Emberiza citrinella)*

This species was common in the tussock grassland between Ruahine Corner and the Otupae Range, especially in the upper Makirikiri catchment, where the tussock is interspersed with manuka scrub. This area is a southward continuation of the tussock grassland of the Taruarau catchment (upper Ngarurоro). One bird was seen on the lower Mokaipatea, but none were seen or heard in sub-alpine tussock or scrub.

CIRL BUNTING *(Emberiza cirlus)*

The inclusion of the Cirl Bunting in this list is based on a single record. One bird, a male, was seen in the Big Hill Stream area in November 1944 (N.L.E.) Cf Fordham's (1961) record of a single bird seen in the Tutaekuri catchment.

HOUSE SPARROW *(Passer domesticus)*

Several sparrows were seen associating with Chaffinches in a small flock near Makirikiri hut (February 1961). A single bird was also seen near farm land west of the Whanahuia Range (January 1962). Both observations were from beech/podocarp forest.

STARLING *(Sturnus vulgaris)*

A few Starlings were seen in the upper Makirikiri catchment where they nested in outcrops of shelly limestone. They were not recorded elsewhere within the range but were often seen on adjacent farm land.

MAGPIE *(Gymnorhina* sp.)

Magpies were commonly seen along the foothills, and in the north-western corner of the range they penetrated the tussock-grassland areas of the upper Mokaipatea and Ruahine Corner. Small groups were

noted on several occasions along the summit of the Otupae Range up to 4,500 feet. Elsewhere in the Ruahines, only one record is known from above the forest line, namely at Mt. Remutupo (V.B.). Small isolated groups (usually consisting of two birds) were also found in forested areas near Colenso Lake, below the Waikamaka-Maropea confluence (A.C.), on Weka Flat (upper Kawhatau River) (V.B.), and upstream of the north Makawakawa hut (Makawakawa River). In each of these localities the birds were seen near natural clearings in the forest, such as those formed by large unhealed slips.

DISCUSSION

Little has been published concerning the presence, distribution and habitat occupation of birds in much of the high country of New Zealand, the main mountain ranges of the North Island being no exception. However, this paper is the fourth contribution from field workers with the Forest and Range Experiment Station, Napier. Those previously published are by Fordham (1961) and Caughley (1962) detailing the birds of the Tutaekuri catchment, and by Challies (1962) on the upper Ngaruroro catchment. The Tutaekuri and upper Ngaruroro catchments lie to the east and west respectively of the Kaweka Range and both have a common (arbitrary) southern boundary — the Napier-Taihape road — with the northern Ruahine Ranges.

The avifaunas of these three areas show great similarity, especially within vegetation types, as is to be expected from the geographic proximity and similar terrain of the regions. Of the species not common to the three areas, the Kiwi and Robin are of special interest because the boundaries of their distributions do not appear to coincide with any change of habitat. Both species, although present in the Kaweka and Kaimanawa Ranges, are either absent or rare in the Ruahines as they are in the Tararua and Rimutaka Ranges to the south.

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WELCOME SWALLOWS IN NEW ZEALAND, 1958 - 1965

By A. T. EDGAR

INTRODUCTION

The Welcome Swallow *(Hirundo neoxena)* is an Australian bird self-introduced to New Zealand. The first New Zealand specimen was a straggler obtained at the Auckland Islands in 1943 (Oliver, 1955) and two stragglers were found at Stewart Island in September 1953 (Sansom, 1954). A single bird observed at the base of Farewell Spit in November 1955 (Heather, 1956) was at that time the first accepted record of occurrence in either of the main islands: however, Michie (1959) reporting the presence of breeding pairs in Northland in 1958, states that some time in the 1920's he had a swallow under observation for more than a week in Kaitaia district and that about the same time a bird was shot at Herekino, some 15 miles from Kaitaia, and its wings displayed in the window of the local newspaper office: he adds that sightings of swallows were reported to him from several localities near Kaitaia over the few years prior to 1958. Mrs. L. E. Walker (pers. comm.) recalls that some time in the 1940's two swallows were reported from Nugget Point, Otago. Various papers in the Transactions N.Z. Inst. published during the second half of the nineteenth century contain notes on visual records of "swallows and martins" in various parts of New Zealand. All these have apparently been taken to refer to the Australian Tree Martin *(Hylochelidon nigricans)*, of which the first New Zealand specimen was procured in 1851 (Oliver, 1955). Discussion of these early visual records of swallows and martins is outside the scope of this paper, but it appears possible that some of the birds sighted were in fact Welcome Swallows, not Tree Martins.

Between 1958 and 1965 the spread of Welcome Swallows over the four northern counties has been rapid and successful, and there have been many records of sightings and establishment of small breeding populations in other parts of the North and South Islands. The purpose of this paper is to place on record what has been learned of the life history and population spread of swallows during their first eight years as a resident New Zealand species. It is a summary of information published in *Notornis*, supplied to the Ornithological Society's Recording Scheme, conveyed to me by interested observers and drawn from my own field notebooks during four years of residence in Northland. I acknowledge with gratitude the work of four junior members of the Society, Terence and Dale Calvert, Robert Cowan and Peter Gross: these boys have accompanied me on journeys throughout Northland totalling many hundreds of miles and have acquired an unrivalled knowledge of the underside of Northland bridges in their search for and observation of swallow nests.

The information which has been collected is presented in three sections — Habitat, Field Characters and General Habits; Breeding; Population Spread. This paper is in no sense a complete study of the species and it will be obvious to the reader that there are many gaps in our knowledge of the life history of swallows, but it is hoped

that this account may provide a basis and a directional stimulus for future observation and detailed study, particularly in areas where the swallow population is as yet at an early stage of establishment. All place names mentioned in the text may be found in N.Z. Automobile Association Motor Touring Maps (North Island Sheets 1 - 4, South Island Sheets 1 - 4) or in A Descriptive Atlas of New Zealand (1960).

The origin of unpublished information given to me either direct or through the Recording Scheme is indicated by insertion of the initials of the contributor after the relevant statement, as per the following list.

Mrs. M. J. Barron (M.J.B.)
B. D. Bell (B.D.B.)
Miss Lois J. Bishop (L.J.B.)
R. Cowan (R.C.)
M. P. Daniel (M.P.D.)
C. W. Devonshire (C.W.D.)
Mrs. A. O. Edgar (A.O.E.)
H. A. Findlay (H.A.F.)
Mrs. R. Hows (R.H.)
F. C. Kinsky (F.C.K.)
R. M. Lockley (R.M.L.)
M. G. Macdonald (M.G.M.)
H. R. McKenzie (H.R.McK.)
N. B. Mackenzie (N.B.M.)
R. H. Michie (R.H.M.)
Mrs. K. Reynolds (K.R.)
M. Ross (M.R.)
R. B. Sibson (R.B.S.)
D. J. Trigg (D.J.T.)
A. Wagener (A.W.)
M. A. Waller (M.A.W.)
W. D. Weymouth (W.D.W.)

HABITAT, FIELD CHARACTERS AND GENERAL HABITS

Habitat

Open country, inland or coastal, where there is water in the form of rivers, streams, lakes or pools. All kinds of open country seem acceptable — flat farmland; undulating farmland with streams or swampy areas in the flats or hollows; scrub-covered gumland; extensive areas of swamp; sand dunes covered with natural vegetation as at Ninety Mile Beach, Northland, or with lupins as on Taranaki Coast (M.G.M.); birds may be seen hunting over mangrove swamps. Heavily forested country is not a suitable habitat though birds have been seen adjacent to large areas of bush on the Waitakere Scenic drive near Auckland (A.O.E., R.B.S.), and over lakes in the vicinity of Waitangi exotic forest. In Northland the swallow population is densest in flat coastal areas, but there is a good concentration on the plateau around Lake Omapere (780 ft. a.s.l.). As the population increases in coastal areas there has been a considerable spread up inland valleys in Mangonui, Whangaroa and Hokianga Counties: in 1965 R. Cowan found nesting pairs near Broadwood in broken hilly country under grass and large patches of bush — a type of habitat which on the basis of previous experience would have been thought quite unsuitable. At Kaitaia and Kaikohe, where swallows are well established, birds may be seen flying within the town area.

Field Characters

Welcome Swallows are small birds (length about 150mm, or 6 inches) with rounded heads, slender streamlined bodies and long pointed wings: adults have long deeply-forked tails, the outer feathers much elongated and attenuate. The black bill is short, flattened, broad at the base and triangular in plan, with a wide gape. The feet are small, black, with unfeathered tarsi and long toes and claws.

The full beauty of an adult swallow in good plumage can only be appreciated when the bird is seen at rest, at close range and in a good light. The upper parts from hind crown to upper tail coverts, scapulars and upper wing coverts are metallic blue-black; the black extends as a narrowing line from the eye to the base of the bill, separating the bright rufous of fore-crown and forehead from the slightly less intense rufous of throat, foreneck and upper breast. The rest of the under surface is greyish white, rather browner on the sides of the body and under wing coverts. The primary coverts and quills are blackish brown, the quills edged with buff: small whitish tips on some of the inner secondaries may be visible when the bird is at rest. The tail feathers are blackish brown, slightly glossed on the upper surface; white sub-terminal wedges on the inner webs of all but the central and outermost tail feathers show as a row of white spots when the bird spreads its tail in flight or when about to settle on a perch.

Young birds are less richly coloured than adults and have shorter tails, forked but without the long streamers characteristic of the adult. The rufous of forehead and breast is much paler and the blue of the upper parts less intense. A very young bird which had left the nest though not quite ready to fly had not yet developed the full rufous forehead; the centre of the forehead was pale greyish blue, with a pale rufous patch over each eye. The edges of the gape were pale yellow. When birds are perched facing away from the wind the ruffled back feathers may disclose whitish feather bases: casual observation of these has sometimes created the impression of a whitish rump patch.

Moulting adults have been noted in mid-March (M.R.).

Flight; Feeding Habits; Perching

Swallows feed on insects, generally taken on the wing. Their streamlined bodies, wide gapes, long wings and considerable powers of flight are admirably adapted for this way of life. The "swimming" flight of swallows is characteristic, light and easy, swift and irregular, with frequent changes of direction from side to side or up and down; long sweeps and glides with wings sometimes extended and sometimes half closed alternate with intervals of direct flight and regular wing beats or with swift swerving and banking; low skimming flights over swamp, paddocks or water are varied by direct or circling flights at moderate elevation or wheeling flights high in the air, sometimes almost beyond the limit of unaided visibility. Swallows are on the wing throughout the hours of daylight, from early morning until darkness falls. M. Ross noted that Kaikohe birds were particularly active after a period of drizzling rain, presumably because these conditions had produced a plentiful supply of insects. I have seen a party of swallows busy hunting through the smoke cloud over an area of burning scrub. During low skimming flights over ponds and lakes swallows often dip to the water, sometimes to drink, sometimes to take an insect from the water surface. On the inlets of Northland swallows fly back and forth, quartering low over stretches of salt water near the shore. The neighbourhood of cowsheds and piggeries provides good hunting. Shanks (1960) reported swallows flying round a cowshed, probably feeding on small insects attracted to the skim milk curds and disturbed when the curd is scattered. R. Simpson noted regular hunting flights up and down a small stream which carried off the drainage from a

cowshed; the outflow of liquid from a stack of silage on my farm was another favoured hunting ground. I have seen birds fluttering along the face of a clay bank apparently taking insects from the short vegetation, and birds skimming over paddocks dipping as if to take insects off the grass blades. Swallows may flutter along the walls, eaves and roof of buildings as might a fantail, and sometimes enter cowsheds and piggeries on hunting flights.

Swallows have comparatively short weak legs and feet and do not habitually alight on the ground but have frequently been observed to do so. They often settle on the muddy shore of the lake at Ngawha Springs, and on my farm and elsewhere I have several notes of ground feeding by small parties on paddocks or farm roads, and many more notes of momentary perching on cowpats and grassland, at times or under conditions which precluded collection of nest material as a reason for settling on the ground. On ground perches the body is held in a horizontal position; gait is weak and waddling. Above ground swallows normally perch in an upright attitude, but if a strong wind is blowing they may swing the body to an almost horizontal position, head facing into the wind. Near the nest swallows perch on telegraph wires, power lines, wire fences, bridge rails, fence posts or battens; any stump, stake or log on land or in water may be used if it is conveniently situated. At Lake Ngatu one bird of a pair sat on top of a post and the other on a six-inch nail driven horizontally into the post and projecting from it. Raupo (*Typha* sp.) serves as a perch if it is near the nest, and at one nest bridge adults perched on a *Phormium* flower head. Birds nesting on boats or at boat harbours perch on launches and dinghies, and along the coast sometimes settle on small projections on clay banks and low cliffs.

Young birds not long out of the nest often perch on the dry branches of trees or bushes washed downstream by floods, or on dead twigs of fallen trees in the vicinity of the nest site. Leafy perches are not favoured, but at flocking time large numbers of birds may perch on trees which are bare of leaf, or on dead branches of trees standing in water or around the edges of lakes. Birds which have nested in or hatched from nests attached to farm buildings perch on roof ridges, roofs, or gutters during the nesting season; I have seen a party of birds fluttering round and settling on the lintels and verandah of a house on the edge of Kaitaia town. In autumn, congregations of up to fifty or more swallows may be seen resting in rows on farm buildings, telephone or power lines, flying around to feed and drinking from adjacent watercourses, pools or water tanks.

Many observers have commented on the tameness of swallows. Michie (1959) writes that a bird preening on a wire a few feet from Awanui bridge took no notice when a heavy cream lorry laden with cans rattled over the bridge. Findlay (1960) describes how swallows at a farm near Kawakawa were quite fearless and would fly within a few feet of a person sweeping the yard. Hall (1960) mentions a swallow perched on a stump which showed no alarm when approached to within twenty feet, and on a number of occasions I have encountered birds which permitted even closer approach. R. Simpson mentions a swallow which flew into a classroom at Te Iringa; it did not panic, but flew around for a while and then perched on the head of a drawing pin stuck in the schoolroom wall.

FOOD

No list of insect species taken by swallows in New Zealand has yet been compiled, but small species of Diptera probably form a large proportion of their diet. Skegg (1962) records that droppings at a nest site contained shiny wing cases of some insect. On a number of occasions it has been noted that proportion of the droppings at a nest site were bright pink; normal droppings are white. Residents in Pukenui district say that the greatly increased swallow population has coincided with a reduction in the number of mosquitoes. K. A. J. Wise (Entomologist, Auckland War Memorial Museum), reporting on insect remains from swallow droppings collected by Miss L. J. Bishop from below a nest on a rocky island at Houhora Heads, states that swallows had been feeding mainly on small flies including midges but not mosquitoes, and that there were also a few remains of small beetles and larger insects. A sample of droppings from near Kawakawa also contained insect remains, mainly of small flies and a few small beetles. Malcolm Ross has seen swallows hunting small blue butterflies.

VOICE

The call note, uttered frequently in flight and less frequently from a perch, is a short single "twit" or "tswit." The same note, frequently and rapidly repeated, runs into a twitter, commonly heard and apparently a conversational note: sometimes this conversational twitter alters somewhat in quality and gives the impression of mutual excitement. I have heard twittering notes uttered by pairs of birds investigating a possible nest site, constructing a nest, or flying to and fro under a bridge on which a nest has already been constructed. Much twittering takes place when a family of young birds take to the air with the parents, and when the young birds return to the nest after a flight. Parties of birds congregated at areas of abundant food supply such as seepages, drainage trickles from cowsheds, piggeries or silage heaps keep up a continuous twitter, as do similar parties fluttering around farm buildings, houses or coastal banks.

The alarm note, as uttered by parent birds when an intruder is near the nest, is sharper and louder than the call note and sounds to me like "tswee" or sometimes "sweert": occasionally it has a bisyllabic sound " tit-swee," accent on the second syllable.

Song is a mixture of squeaky twitter and trills, not loud and of low carrying power, but pleasing to the ear. Duration of each song varies from three to about 12 seconds, and the song may be single, repeated two or three times, or continued in a series lasting up to a minute. I have notes of singing from August till January, sometimes on the wing, more often from a perch. Possibly song on the wing occurs more frequently than my notes indicate: there are few windless days in Northland and so small a song from flying birds could pass unnoticed when a wind is blowing. The longest series of songs I have heard was from a bird perched on a stump near a bridge which the pair was investigating as a possible nest site (which in the event was not found acceptable). Shorter songs I have heard on a number of occasions from birds on wire perches near a nest under construction (sometimes the first nest of the season, sometimes a second nest built when the first had fallen down after a brood had flown): less frequently

males were heard singing short songs from a nearby perch while the female was on the nest. In January, a male bird sang from a wire perch while two other adults and a family of four young birds perched or flew around the nest bridge (R.M.L.).

FLOCKING

The main nesting season in Northland is from August to December with some nests still occupied in January and February. Young birds remain in the neighbourhood of the nest site for a period which may vary from a few days to several weeks, while the parents rear another brood: sometimes I have seen parties of young birds which appeared to be composed of a first and a second brood still around the nesting area while the parents were busy with a third clutch. By November, still well before the end of the nesting season, flocks of 20 - 25 or in the Far North even larger gatherings of young birds are frequently seen.

From late December flocks of old and young birds begin to form. In December 1963 a flock of over 50 birds congregated around farm buildings at Kerikeri Inlet: by 5th January 1964 the number was reduced to 17, and about this number remained till 12th March, when they left the area. A similar gathering was noted at the same place in December 1964. Ross (1962) records a flock of 40 - 60 birds near Ngawha on 17th February 1962, and from Te Iringa (south of Kaikohe) a flock of 32 on 10th February 1962 which increased to 37 on 20th February and for a brief period on 22nd February to about 100. Smaller numbers were seen until about 12th March, when they left the area.

It may be that this autumn flocking is in some way connected with an inherent migratory urge, but I have no evidence of migration and the dispersal of autumn flocks noted above may merely indicate that the birds have moved on and joined another flock where food supply is more plentiful. Winter flocks have been recorded all over Northland: A. Wright reports a winter flock of c. 100 birds from Kaitaia; Ross (1962) records flocks of 20 - 30 birds seen at Kaikohe sewage farm from May to August 1961, similar numbers in June 1962 and (pers. comm.) in July 1963. He also records a large flock at Kauri Log Lake, Ngawha, in July 1962. A winter flock of c. 100 birds has been seen at the nearby Lake Tuwhakino and a smaller flock at Moerewa oxidation pond. (H.A.F.).

A flock of over 50 birds was seen over a lake near Waitangi in May 1964, and over the three winters 1963 - 65 flocks of 30 - 50 birds visited a 5-acre lake on my farm at irregular intervals and flocks of similar size were seen elsewhere in Bay of Islands County. It appears that these winter flocks range widely from one feeding ground to another: appearances of flocks over my farm lake have varied from three to seven days in any one winter month. Sometimes a flock stays around the lake for three or four days, but more often flocks are present for one or two days only and may not be seen again for a week or a fortnight, during which period flocks of similar size are reported from other parts of the district.

A proportion of the swallow population does not join the winter flocks: throughout Northland there are many records of pairs or small parties remaining around the nest area during winter, sometimes using the old nest as a roost. Throughout each winter small numbers of

swallows are around my farm most of the time, quite distinct from the larger flocks which visit it at intervals. The nearest known nest site is about 1½ miles away. It would appear that the food requirements of the swallow population in winter are met partly by flocking, partly by dispersal into smaller parties and partly by continued occupation of such nesting areas as provide sufficient food supply for a limited number of birds. The number of swallows seen by travellers through a district at any time outside the main nesting season is therefore not necessarily a true indication of population abundance in that district. It is a matter of luck whether a traveller happens to encounter an autumn congregation or a winter flock, and apart from these he is likely to see only late nesters, or birds which have not flocked and may be either around nest sites or ranging farther afield than they would during the nesting season.

Although I have no evidence of migration, one record suggests a possible northward movement. On the evening of 18th May 1963 a party of thirteen swallows appeared on a paddock near my house. They were new arrivals, and obviously very tired. They perched on cowpats and on the ground and when approached were most reluctant to move and only flew a few feet to alight again on the ground or on a fence wire. The following day they were still there, flying around but still not particularly active. The next day the flock had gone, leaving only the three or four birds which had been in the area daily before the party arrived and remained after it departed. The wind had blown from the south-east on 15th - 17th May and from the south on 18th May.

BREEDING

Some of the material in this section is drawn from the published or unpublished notes of other observers but most of it is from my own notebooks. During 1962, 1964 and 1965 seasons routine checks have been carried out at approximately weekly intervals on a number of swallow bridges within thirty miles of my home at Kerikeri and in the course of these I have gathered some useful information. This is supplemented by notes made during the period 1961 - 64 on nests outside the routine study area, and in 1965 by the results of an investigation of the present distribution of swallows in the four northern counties, in the course of which I have travelled some hundreds of miles and recorded about 270 nests.

The substance of what has been learnt about siting and construction of nests, eggs and dates of laying, clutch size, incubation and fledging periods, hatching and fledging success is summarised in the following pages, which however make no claim to be more than a preliminary survey. A total of 112 clutches or part clutches was recorded in the routine study area, but the regularity of recording suffered frequent setbacks. Sometimes flooding of streams interrupted the sequence of inspections; nests or their contents were lost (often at a critical time) by accident, vandalism or predation. When a bridge is occupied by several pairs and when re-nesting takes place after more than one nest has been lost it can be difficult or impossible to establish with certainty the ownership of the new nests; in sites occupied by only one pair of birds a lost nest may be replaced by a new one placed in an inaccessible position. Because of these hazards it was possible to follow the breeding sequence of only a limited number of pairs through the whole of

each nesting season. I have not yet had an opportunity to study closely the day-to-day breeding activities of individual pairs; nests that were geographically convenient were either inaccessible or awkwardly sited for observation. Much more remains to be done in this direction, but this general survey may serve a purpose in drawing attention to variables which might not be apparent in a more detailed study of individual pairs.

Selection of Nest Sites

During the early years of their establishment in Northland swallows have exhibited a marked preference for nest sites over flowing water and up to 1964/65 about 95% of the nests recorded in my notes were attached to concrete bridges, wooden bridges and culverts, the proportion of nests on each type of construction being approximately as 100:50:10. I find no particular significance in the relative numbers of nests under concrete and wooden bridges and think this is more an indication of the type of bridge site available than of any other factor. In the Far North there existed a high proportion of wooden bridges, and further south most of the main road bridges were concrete, with many wooden bridges on side roads and on farms. Gradual replacement of wooden bridges by concrete or steel and concrete bridges need apparently make little difference to the swallows and the location seems more important than the type of bridge. In a number of cases where swallows previously nested under a wooden bridge and where this has now been replaced by a more permanent structure, the birds are using the new bridges as nest sites.

Writing of swallows in Australia Mathews (1919) states "they nest in a great variety of situations such as down wells, in caves, on the side of or under a ledge on a rocky cliff, inside dwelling houses, open hollow trees, inside empty 400-gallon tanks, on rafters on outbuildings, etc." Serventy and Whittell (1962) state "favourite sites are the verandahs of country railway stations, shops and hotels. The nests may also be built under bridges and jetties . . ." Mathews does not mention bridges at all, Serventy and Whittell place bridges fairly low on the list of preferred nesting sites. It is interesting to compare these passages with the situation in New Zealand, where a summary of nest site preferences could read "most swallows nest under bridges and culverts, some on houses and outbuildings and a few in other artificial or natural sites." It may be that the birds which first made their way from Australia to New Zealand were bridge-nesters, and that this preference has been transmitted to their descendants, to be modified over the years by various factors. Shortage of suitable sites could be one cause; another cause could be successive failures to raise a family from a nest under a bridge. In 1959/60 a pair at Kawakawa were driven from their nest bridge by persecution and shifted to a bowling pavilion where they built a nest and raised young (H.A.F.); another bridge near Moerewa had been used as a nest site for some years but nests were persistently interfered with or destroyed by children and no nest was built on this bridge in 1965/66 season. Several bridges on the main road Hikurangi-Kawakawa had been occupied in previous seasons and the birds were back again in 1965 Spring but were driven away by a programme of spray painting the undersides of the bridges and presumably nested elsewhere.

Skegg (1962) records our impression that swallows favoured as nest sites bridges which were so situated that the birds could have a clear sweep through under the bridge and that bridges where this was hampered by presence of willows or other vegetation were not favoured. Subsequent observations confirm that this impression remains substantially correct but with the rapid rise in swallow population and increasing demand for sites, nests are now being built under many bridges and culverts where entry and exit conditions are less easy than appeared to be desirable in early 1962, and in some situations which would then have seemed quite unsuitable. In 1965 nests were found inside two pipe culverts, the downstream ends of which were blocked by floodgates; in each case the nest was well inside the culvert near its closed end.

The wide variation in placement of nests under bridges makes it impossible to generalise on the factors which affect selection of the particular position in which nests are placed. Michie (1959) noted that Awanui birds apparently chose a site under the end of a wooden main-road bridge in preference to any other part of it because the vibration from road traffic was less at that point, although nearer the centre of the bridge the nest would have been over the water and safer from interference. Under other main road bridges of solid construction which eliminates the vibration factor nests have been built year after year in situations vulnerable to human interference though alternative safer sites were readily available. There are signs that the human interference factor is beginning to imprint itself on the consciousness of some pairs; on several bridges nests were in previous years placed in accessible situations but are now situated high up under the crown of the bridge and over deep water. On the other hand, several big bridges on which nests had in previous years been built in inaccessible positions have now been abandoned in favour of small bridges, low over the water of streams, in the same area. A possible reason for abandonment of the big bridges could have been that the site was exposed to too much wind and sunlight.

Nests in pipe culverts or under wooden bridges on by-roads and farm roads may be as low as $1\frac{1}{2}$ - 2 feet above running water and in such situations are liable to be submerged or washed away by flash floods. Under other bridges nests may be placed at any height from 3 - 15 feet above ground or water level, and on buildings from 5 - 25 feet above ground. Although the placement of nests indicates little instinct to guard against human predation there is a measure of protection against other predators in that a large proportion of nests are so constructed that there is only a narrow (40 - 80 mm.) gap between the nest rim and some horizontal or near-horizontal surface above it (bridge decking, beam or eave). This often makes inspection of nest contents quite difficult, even when using an adjustable mirror on a pole.

Records of nesting on buildings were sparse until a year or two ago. I have already mentioned a nest in Kawakawa bowling pavilion in 1959 and Shanks (1960) reported nest building in a shed at Waiomio the same year; my other records from Bay of Islands County are recent ones from a farm cottage at Pakaraka, a farmhouse north of Waipapa, and attempted nesting on a house at Kerikeri Inlet, but there may be others of which news has not reached me. In Mangonui County birds nested in a woolshed near Herekino in 1961/62 (R.C.) and in

1963/64 in a boatshed at Awanui (R.H.). For 1964 and 1965 there are, however, numerous records of nests on farmhouses, cowsheds, piggeries, etc., a nest is reported to have been built on Herekino post office, and for two seasons there has been a nest under the eaves above an upstairs window at Houhora Hotel. From others parts of Northland I have records of a cowshed nest near Broadwood, a nest on a piggery at an inland farm in Whangaroa County, and one on a pumphouse at Poutu (M.J.B.). Nests have been found under Northland jetties at Pukenui, Kohukohu and Waitangi. Birds nested inside an old "pill-box," relic of 1939/45 war, at Kerikeri airfield; entry to the pillbox was by a small manhole or through square nine-inch gunslits and the nests were on the inside wall. Turbott (1965) mentions attempted nesting inside a concrete water guage in Canterbury and possible nesting in a converted railway carriage used as a caravan. Birds at Okaihau nested on a water tower and at Pukenui each of two reservoirs (constructed of concrete slabs and with a corrugated iron cover) had a nest, one built on the inside wall and the other on the wooden framework which supported the cover; entry was possible only through the narrow opening between the top of the uppermost slab and the sheets of corrugated iron. At Waipukurau swallows nested inside a corrugated iron tank for three seasons (B.D.B.).

Michie (1959) records nesting under a rickety wooden platform used by boatmen, three to four feet above the water and about a chain and a half from the lake edge at Lake Ngatu (Paparore). In 1962 birds were nesting at the came place under a similar structure, then used as a ski-ramp. Turbott (1965) records nesting in a launch at Lake Ellesmere in 1961/62, 1962/63, probably 1963/64 and certainly 1964/65 season; the first nest, which was destroyed by the owner of the launch before he realised what it was, had been built against the glass of the cabin window. Subsequent nests were also inside the cabin but on a ledge towards the bow. Swallows nested in the cabin of a boat anchored in Awanui Creek in 1962. Eggs were laid and hatched; the boat went to sea with the swallows on board and the parents continued to feed their chicks after it had returned to its anchorage (R.H.M.). In 1965 birds nested in a launch at Kerikeri Inlet, and in an old boat pulled up on the beach near Te Kao wharf there was a nest with four eggs in December. This nest was inside the cabin, just above the entrance; having entered the cabin the observer had to turn round to see it, and the parent bird had to double back to settle on the nest.

Swallows attempted to nest in the cabin of a truck at Houhora Heads (L.J.B.), and in the cabin of a dragline excavator left standing on the job over the week-end, near Moerewa (D.J.T.). Near Motutangi a cave has been hollowed out of a consolidated sandbank and houses a number of pigs. On the wall of this cave a swallow nest was found attached to the soft sandstone. The investigator who entered the cave after we had seen a swallow fly out was somewhat alarmed by the hurried exodus of startled swine.

Tokoroa Island is a basalt stack in the channel at Houhora Heads. On the leeward side and just above high water mark there is a large hollow or small cave about five feet high and five feet deep. A swallow nest was built on the rock wall in a small pocket well protected by overhang. The site was occupied in December 1965 and had been used in two of the preceding three years (A.W.).

I have seen a nest in a hollow on the crumbling cliffs at Kaimaumau and there are reports of nests built on sandstone cliffs or steep banks at Henderson Bay, at some inland localities north of Awanui (A.W.), and at Coal Creek, Ninety Mile Beach (L.J.B.).

Territory

A survey of nesting sites in Northland during spring and summer 1965 produced some interesting information on exceptions to the general rule "one site, one nest." In Table 1 figures are presented for two hundred nest sites, one hundred in Mangonui County and one hundred in other parts of Northland. Most of the sites were bridges and culverts. Nest figures refer to nests actually in use or obviously recently used; broken or partly built nests are not included.

TABLE 1

	Nests per site				Total	Total
	one	two	three	four	sites	nests
Mangonui	79	16	3	2	100	128
Eleswhere	90	9	–	1	100	112
Total	169	25	3	3	200	240

Although the higher figure for Mangonui County may in some degree be due to the density of swallow population in that area, I am doubtful whether this factor as yet greatly influences the situation. Ledgard (1960) found one nest in use and two which appeared to have been used in 1958/9 season under a bridge at Tokerau; Graham (1960) found two nests with eggs and a third nest partly completed under a bridge at Herekino. In Bay of Islands County Ross (1960) records two nests under a bridge at Te Iringa and Shanks (1960) four nests under two bridges at Waiomio. There was no population pressure in those early years, so I think it can be assumed that a proportion of the swallow population has a tendency to a mild form of colonial nesting. The bridge at Waiomio which was occupied by one pair in 1958 and two pairs in 1960 was used by five pairs in 1964 and four pairs in 1965. Pukenui jetty (not included in Table 1) had in December 1965 one nest with five eggs, two other nests each with a sitting bird, one new nest being built, and the remains of an old nest.

Multiple nesting is not necessarily connected with the size of the bridge. Skegg (1962) records five nests, four of which appeared to have been in recent use, under a wooden culvert on Kaimaumau road (it had only one nest with five eggs in December 1965). Of the two Mangonui records of four-nest bridges in Table 1, one was a small wooden culvert, the entrance to which was partly closed by growing flax; the other was a medium sized concrete bridge with steel girders which had replaced a culvert where Skegg (1962) reported two nests.

Courtship

After a pair have arrived on their chosen territory and before nest building starts a few days are spent in courtship activities. The pair indulge in high level chasing flights, following each other around in wide swift circles; and at much lower levels slow, sometimes almost hovering flights are accompanied by much tail fanning by one or

both birds. A pair may sit close together on a wire perch, uttering a crooning twitter and occasionally rubbing bills. I have sometimes seen courtship feeding, the hen sitting on a perch, the male flying round. Each time he approaches she makes a little movement, or opens her bill; sometimes he flies past and continues his flight for a time before returning. The offer and acceptance of food may take place after he has settled beside her on the perch, or as he hovers in front of her. On August 5th 1965 a swallow was seen at Kerikeri chasing a wind-blown feather floating through the air. Judging by known dates of laying first eggs in the district that season this may have been a little too early a date for collection of final lining material; pursuit of the feather may perhaps have been in play or in some way a part of pre-nuptial activity.

Nest sites which have been used in previous years seem to be accepted with little ado other than normal courtship behaviour, but looking for new nest sites sometimes involves much indecisive activity. A pair on my farm spent from 4th - 20th October going from one prospective site to another — a concrete cattle-stop bridge, a hayshed, an implement shed and a woolshed — each site holding their attention for a few days; none proved acceptable and the pair departed to nest elsewhere.

I have noticed that nest sites which have been used in previous seasons are often taken up early in the new nesting season and that new sites may not be occupied till a month or six weeks later. This leads me to think that perhaps old birds tend to nest early, using known sites, and that nesting activities of young birds are often delayed until much later in the spring.

Nest Building

Swallows make mud nests and the eggs are laid on a lining of feathers. Nests may be attached to a vertical surface or placed on a horizontal or sloping ledge. There is considerable variation in the size and shape of individual nests, depending on their situation.

Both sexes build. Michie (1959) writes: "I was able to watch both birds at close range for more than half an hour. They were gathering mud from the lake edge, flying to the same place each time, hovering for a few seconds three feet or so above the ground, then diving down without alighting and scooping a mouthful of mud, after which they returned to the site of the nest. After several trips they flew further afield and out of my sight either to get a snack or to gather grass straw to mix with the mud. On these trips they would be away four or five minutes and as their flight is so rapid I could not see whether they carried any straw or not." Quite frequently swallows alight on the ground to collect mud or straw, and when so engaged often display marked indifference to the presence of humans in the vicinity. This was particularly noticeable with a pair of birds at Waitangi; they went on with the job of mud collection from the edge of a wet patch of soil without any apparent regard for the movement around them of people working on their boats. The mud is carried to the nest site and attached to a vertical or horizontal surface, subsequent mud pellets being added, compacted and reinforced with vegetable or other material as the mudwork of the nest takes shape.

When the nest is attached to a vertical surface without any support beneath, construction commences by making a small mud bracket,

which eventually becomes the bottom of the mud structure. More mud is added to the top and sides of the bracket till it gradually assumes the shape of a shallow U; from this the sides are built outwards and upwards till the mudwork becomes a shallow bowl with firm rims and a deep base, but with a gap of varying depth at top centre of the area of attachment which still gives this part of the nest, when removed from the wall, the U appearance. This is illustrated in Figure 1 in which A, B and C show the variation in size and shape of three unsupported nests as seen in rear elevation (i.e., the flat surface of attachment to a vertical wall). A1, B1 and C1 show the same nests in plan (i.e., as seen from above).

The inside of the bowl (egg chamber) is lined first with vegetable or other material and later with feathers. Generally one type of mud is used for the whole construction but I have seen some nests where part was made of yellow and part of grey clay, and a few in which pellets of yellow and grey clay were mixed throughout the structure, sometimes unevenly and sometimes more or less in layers. Compacting material used in the mud structure may be dry grass, an occasional blade of green grass, rootlets of grass or ferns, scraps of fibrous material, fragments of wood, small land weeds or pieces of green water weed. Turbott (1965) lists leaves of *Ruppia* sp., a few fruits of *Lemna* sp., a seed and some leaves of *Trifolium* sp., some fruits of *Festuca arundinaceae* and a filamentous green algae as strengthening material used in a partly completed nest collected from a water gauge in Canterbury. Some nests have a little cattle or horse hair in the nest rim.

The first lining in some nests is mainly grass straw; in others a mixture of grass, rootlets, scraps of fern, small dry leaves, fine fibrous material and sometimes cow, horse or dog hair and some short fur; often a pad of sheep's wool forms part of this lining. The feather lining may be so generous that the feathers project over the nest rim and the eggs can hardly be seen amongst the feathers, or relatively sparse. A profuse feather lining may be individual preference or merely an indication that plenty of feathers are easily available; a sparse feather lining may be due to shortage of feathers, related to use of much wool in the nest lining, or due to lack of time; a nest is often well lined with feathers for the first clutch, less so for the second or subsequent clutches. Many kinds of feathers are used, depending apparently on availability; chicken feathers, black, white, mixed, or coloured; duck feathers of various colours, and feathers of Turkey, Pheasant, Guinea Fowl, and Red-billed Gull have been noted. Usually the feather lining is loosely laid but one nest had the feathers pressed into a tight pad. Some birds seem to be selective and many discarded feathers may be found below the nest, others seem to use what comes and throw none away, at any rate in the nest vicinity. 30 to 65 feathers have been counted in the inner lining of nests; in the nest with 30 the feathers were rather larger than usual.

Skegg (1962) notes our impression that the rougher the surface to which the nest is attached the less deep the area of attachment, and vice versa. In the light of further experience I now suggest that security of attachment to a relatively smooth surface is increased by a larger total area of attachment rather than by extra depth alone. Nests A and B were on relatively smooth walls, nest C on a rougher wall. Details of the three nests are as follows:

	A	B	C
Greatest breadth (side to side), mm.	150	205	115
Greatest width (back to front), mm.	90	90	85
Greatest depth, mm.	95	85	80
Depth of egg chamber, mm.	40	42	30
Weight in ounces	12	10	6

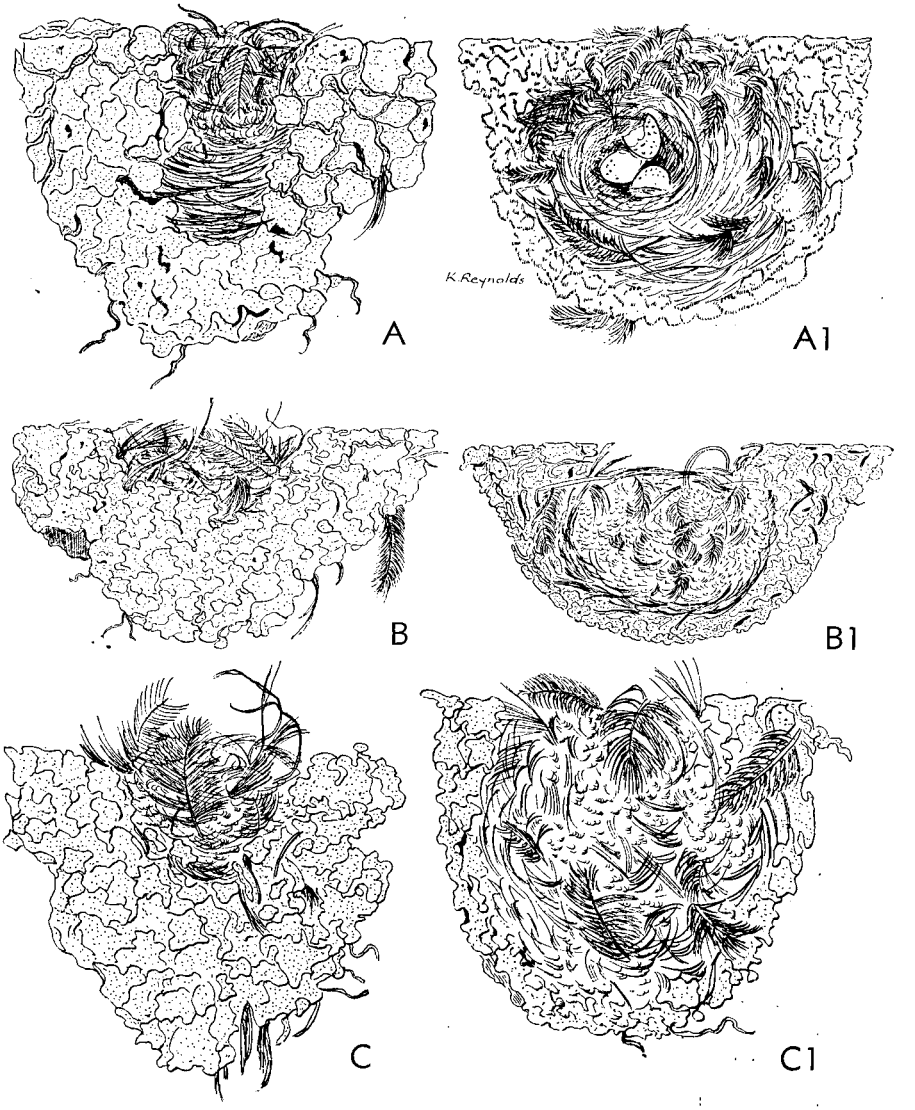


FIGURE 1 — Swallow Nests (not to scale)

In most nests the egg chamber is roughly circular and about 60-80 mm. across at the rim. Skegg (1962) found that egg chambers were normally 30-35 mm. deep, but had one nest with an egg chamber 50 mm. deep, this probably because instead of the normal 40 - 80 mm. gap between the top of the nest rim and the horizontal surface below which the nest is placed, this particular nest had very little headroom because it was built close to an angle in the wall which sloped forwards just above the back of the nest.

Unsupported nests under concrete bridges may be attached to retaining walls, buttresses or beams; those under wooden bridges to supporting beams or cross beams (log, squared timber or concrete). Concrete bridges without beams and with smooth vertical walls are not favoured as nest sites. Under one wooden bridge the clay bank was retained by a rough plank wall with vertical gaps between the planks. A nest was built across a gap, attached to the two planks and with a projection of its rear wall which anchored it to the clay between them. In a pipe culvert a root had grown through the gap between two pipes. A nest was built across this gap, with its rear wall extended into the gap and around the ingrowing root, which helped to support an otherwise precariously sited construction.

Unsupported nests are insecure and often fall with their own weight. Only a limited number last for a full season and so far I know of only two cases where such a nest was fit for use in a second season. All early nests reported were of the unsupported type but Skegg (1962) recorded from Houhora a small cup-shaped nest only 30 mm. deep placed on top of a culvert pipe. In 1962/3 season I found a nest at Waiomio placed on the flat flange of a steel girder under a wooden bridge. It was 90 mm. from front to back and 55 mm. deep, with a flat bottom where it sat on the horizontal surface and a flat back against the vertical surface. Like unsupported nests it had a gap in the back mudwork which in this case extended right down to the bottom of the nest and was filled with the grass lining. This was the first flat nest I had seen in this district where most of the bridges then under observation were of types which required construction of unsupported nests. Flat nests, however, are becoming increasingly common in Northland wherever the type of bridge provides a suitable supporting surface; I have seen nests placed on top of wooden beams, and some built partly on the projecting malthoid layer between wooden beam and steel girder; this is a rather insecure foundation as the malthoid sags with the weight of the nest, which tips forward. Flanges of steel girders are being used, when available; very small nests have been built on top of projecting bolts, and equally small nests, triangular in side elevation, have been built on top of diagonal steel struts near their junction with the girder. Under two wooden bridges flat nests had been placed on top of a pile of silt which had accumulated close under the decking. This gradual change in nest construction is all to the good as flat nests are smaller, easier to build and much more durable than unsupported nests.

Building of the first unsupported nest of the season usually appears to take nine to twelve days; mudwork is finished in four to six days and sometimes there seems to be a pause in activity when this is accomplished and before lining operations are put in hand. Building of second and subsequent nests after earlier nests have fallen or been knocked down is a much quicker process, usually completed in about

six days, four of which are occupied on mudwork and two on lining. I have as yet no record of the time taken to build a flat nest. When a nest falls down a new nest is generally built near the site of the old one, sometimes in exactly the same location. When a nest has broken off but part of its base is still fixed to the wall the birds sometimes, but infrequently, build a new nest up on the old structure. When a crack develops in the mudwork due to vibration or other causes and during the incubation or fledging periods, the birds sometimes carry out emergency repairs, bringing new mud pellets to close the crack.

Eggs

With the first clutch of the season the time-lag between apparent completion of nest lining and laying of the first egg seems to be usually three to six days. Sometimes (perhaps due to bad weather) this may be extended to a week or ten days, occasionally even longer. One nest was apparently fully ready on 6th October but the first egg was not laid till October 23rd. With second and subsequent clutches my records show that the first egg may be laid as soon as lining is completed, usually within one to three days of completion, occasionally four to six days. In one case I saw a male bird bringing a feather to a nest in which the hen was sitting, having already laid two eggs of her second clutch of five.

Eggs vary in shape, some being blunt ovals and others tapering towards the smaller end. Blunt and tapering ovals may be found in the same nest. The eggs are white, with a pinkish tinge when fresh, speckled and blotched with shades of brown or reddish brown and a few light grey undermarkings. The speckles and blotches are variable in density and distribution. In most eggs they are concentrated mainly in a zone at the larger end, with sparse markings on the rest of the egg. In other eggs the zone is present but the rest of the egg is more profusely spotted, and in some there is little or no suggestion of a zone, though there may be a cluster of closely set spots somewhere on the large end and scattered spots elsewhere. A few eggs have only a few small scattered blotches and otherwise the markings consist of irregularly distributed brownish specks.

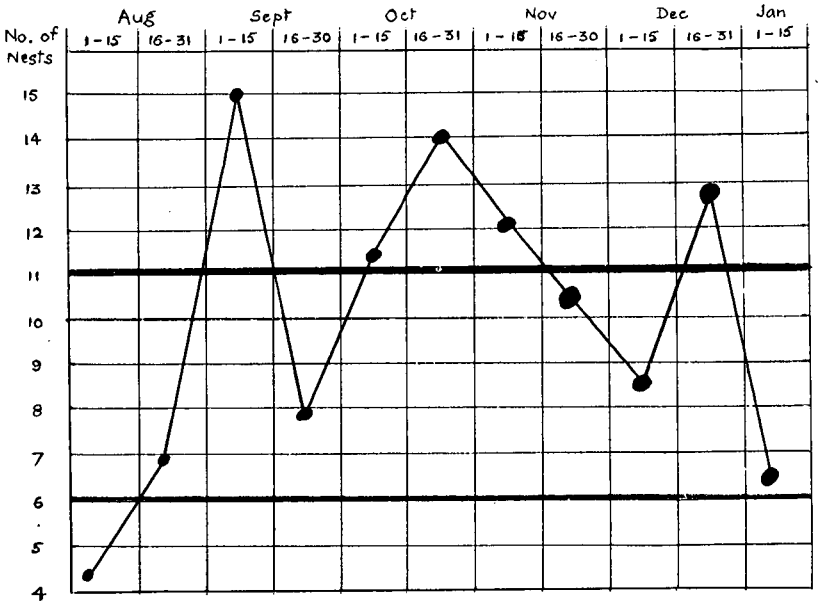
Michie (1959) records measurements of two eggs as 17.5 x 14 mm. Skegg records three eggs at 18 x 12.5, 17 x 12.5 and 17 x 12 mm. R. Cowan measured a clutch of four eggs at 17.5 x 12.5, 17 x 13.5, 18 x 13 and 18 x 13; and two eggs, the fifth attempt of this pair in 1965 season, at 17.5 x 13 and 16 x 12.5 mm. I have measurements of five single eggs at 17 x 13.2, 17 x 14, 17.5 x 13.8, 18 x 14 and 19 x 13, and of a clutch of three eggs at 18 x 13.5, 18.8 x 13.5 and 19.2 x 13.0 mm. The average of nineteen eggs as above detailed is 17.7 x 13.2 mm., and the range 16 - 19.2 x 12 - 14 mm. Serventy and Whittell (1962) give a range for Western Australia of 18 - 19 x 13 - 14 mm.

Records of Laying of First Eggs

The graph at Figure 2 summarises information recorded from 103 clutches over three seasons at nest sites in Bay of Islands County. This sample gives, I think, a reasonably accurate picture of the sequence of nesting in that area. The three peaks indicate the times at which maximum numbers of first, second and third clutches are laid. A few second clutches were laid in late August and September after the first clutch had been accidentally lost. Third clutches were spread over the period November - January.

There are a few records of late laying from different parts of Northland. Skegg (1962) records a fresh egg at Houhora in the last week of January; Flux and Wilson (1965) found two nests with single eggs and one with a clutch of three in the third week of February. Ross (1960) mentions an egg laid in a Te Iringa nest in the last week of February and (pers. comm.) a nest with two eggs at Kaikohe on 9th February. The Te Iringa egg did not hatch, and in my experience a fairly large proportion of eggs laid after mid-January are infertile or deserted.

FIGURE 2



The four August 1/15 records are for 1964. In 1965, first eggs from the same four nest sites were about three weeks later. In 1964 July was wet and relatively mild, and rain fell on 23 days; August had rain on 19 days. In 1965 rain fell on only 14 days in July and 16 in August; there were several days of overnight frost between 12th and 20th July, and a few very light frosts at the beginning of August.

Incubation

As far as I have been able to ascertain, egg-laying takes place in the early morning and one egg is laid each day till the clutch is complete. It is probably correct to assume that brooding normally commences when the last egg has been laid. On several occasions, however, I have found a bird on the nest about noon, or in the afternoon, when only part of the full clutch has been laid. Many more careful observations are needed to ascertain with any degree of exactitude the time and pattern of laying and the period of incubation. At this stage I can only state that the period of incubation from laying of

the last egg till hatching of that egg is about fifteen days. A number of clutches are known to have hatched on the fifteenth day. I think, but cannot be certain, that in a few nests eggs hatched on the fourteenth day. One nest in which the full clutch of three eggs had already been laid by 1200 hours on 12th September still had three eggs at 1710 hours on 27th September. The eggs subsequently hatched. If this took place on the morning of 28th September this would be the sixteenth day.

Generally all fertile eggs of a clutch hatch on the same day but three examples indicate that this may not invariably be the case:

Date and Time Inspected	Chicks in nest	Final number hatched
October 7th 1700 hrs.	two	four
October 9th 1700 hrs.	one	three
November 15th 1730 hrs.	one	two

In each case the time of the inspection was approximately an hour and a half before sunset.

I cannot say whether the male takes any part in incubation. From the number of occasions when at various times of the day I have found fertile eggs uncovered by either parent it is apparent that periods of inattentiveness are not infrequent.

Fledging

Such information as I have been able to record shows that the fledging period varies from eighteen to twenty-two or twenty-three days, and is generally twenty or twenty-one days. Under incubation I mentioned a clutch of eggs which had not hatched at 1710 hours on 27th September and were assumed to have hatched on the morning of September 28th. These three chicks were observed to leave the nest and fly around with their parents at 12 noon on October 16th, i.e., the eighteenth day from hatching. Flight was reasonably strong and there was no indication that their departure from the nest was premature or due to panic; the parents were rather excitable but the chicks flew well.

A brood which hatched on 24th December were perching, but not yet ready to fly on 11th January, the eighteenth day. A brood which hatched on 23rd December flew from the nest on 11th January, the nineteenth day. I have several records of a fledging period of twenty or twenty-one days. A brood hatched on 10th November appeared to be fully fledged but showed no inclination to leave the nest on 1st December, the twenty-first day; a brood hatched on 16th September exploded from the nest on the evening of 9th October, the twenty-third day. It is, however, possible that they had flown earlier that day, or perhaps even the day before, and returned to the nest to roost.

When first hatched the chicks are naked, with long necks, large heads and closed eyes. The eyes open about the third day. When the chicks are only a few days old it is usually fairly easy to count them even if the nest is in a dark corner; if one scratches lightly with one's mirror on the horizontal surface above the nest this usually produces a full muster of open yellow gapes. As the fledglings grow bigger and wing and tail feathers start to grow, and particularly in the later stages of growth, the nest becomes so full of chicks that it is often

difficult to tell how many there are in it; only one or two may respond to the mirror scratching while the others, full fed, sleep on.

Chicks are fed by both parents, usually at fairly short intervals in the morning and the evening but at longer intervals during the heat of the day. G. J. H. Moon (pers. comm.) informs me that at one nest he watched, nestlings were not fed for periods of up to two hours in the forenoon and up to three hours later in the day, but were apparently unaffected.

Nest sanitation is efficient. I have no conclusive data on cessation of production of the faecal sac; in the later stages of development chicks squirt over the edge of the nest, but fouling of the nest rim is surprisingly infrequent. Empty eggshells are removed by the parent; occasionally one finds them below the nest but generally this is not so, and they must be carried away for some distance.

A few days before the chicks are ready to fly individual chicks may be seen stretching their wings and moving them up and down. In the last day or two chicks may perch on the nest rim, or leave the nest and move along the horizontal surface on which it is placed (girder flange, beam, etc.), should one be available. Chicks hatched in nests attached to a vertical surface can of course go no further than the nest rim until they are ready to fly.

Chicks which are nearly but not quite ready to fly may panic when the nest is approached and take premature flight. This does no harm if the young birds are sufficiently grown to permit a short flight and immediate return to the nest as soon as the apparent danger is past but sometimes one chick, less developed than the others, may be able to do no more than flutter down at an angle, and have to be retrieved from the water, long grass or a blackberry thicket and returned to the nest. Chicks which have flown voluntarily at due time may at first spend only a brief period on the wing before they return to the nest to rest, but soon undertake much longer flights, returning to the nest to roost for a day or two, and in any case roosting in the vicinity of the nest for a few nights before they travel further afield. Parents may be seen feeding flying young on the wing.

Clutches and Clutch Size

For Australia, Mathews (1919) states "Clutch, three to five." Writing of Western Australia, Serventy and Whittell (1962) state "the clutch consists of three, sometimes only two, and on occasions as many as four eggs . . . two broods are raised annually."

In Northern New Zealand swallows are double-brooded or treble-brooded and the clutch is usually three to five, with one record of two. A sample of 132 clutches from the Bay of Islands gives the following result:

Clutch	Number of Clutches	Percentage
Two	1	1
Three	31	23
Four	57	43
Five	43	33
	132	100%

One egg hatched from the two-egg clutch, the other was infertile.

A breakdown of the above clutch records by months of laying is as follows:

Month	Eggs in Clutch 2	3	4	5	Total Clutches
August		4	5		9
September		3	12	11	26
October		5	9	15	29
November	1	7	71	9	34
December		10	11	8	29
January		1	3		4
February		1			1
	1	31	57	43	132

Of forty-three five-egg clutches, five were certainly and three probably first clutches; thirteen were certainly and fifteen probably second clutches; four were certainly and three probably third clutches.

The period between vacation of the nest by young birds and laying the first egg of the next clutch varies; in two cases it was only seven to eight days, frequently eleven to thirteen days, sometimes up to three or four weeks.

Sequence of Clutches; Hatching and Fledging Success

In Tables 2, 3 and 4 figures are presented from the records of twenty-five pairs on which it was possible to keep a check throughout one or other of three nesting seasons. The following symbols indicate the fate of nests, clutches or fledglings lost:

(a) = eggs disappeared from nest before hatching.
(b) = nest fell or was knocked down; subsequent layings (if any) in a new nest.
(c) = eggs infertile, deserted or did not hatch.
(d) = young disappeared from nest before fledging.

TABLE 2

Record of six two-clutch pairs

Pair No	One		Two		Three		Four		Five		Six	
Clutch	1st	2nd	1st	2nd	1st	2nd	1st	2nd	1st	2nd	1st	2nd
Eggs	3	4	4	4	4	4	4	5	4	5	5	5
Hatched	3	4	1	2	2	3	4	2	(a)	5	5	4
Fledged	3	3	1	2	2	3	4	2	-	5	5	4

TABLE 3

Record of six three-clutch pairs

Pair No	Seven			Eight			Nine			Ten			Eleven			Twelve		
Clutch	1st	2nd	3rd	1st	2nd	3rd	1st	2nd	3rd	1st	2nd	3rd	1st	2nd	3rd	1st	2nd	3rd
Eggs	3	4	3	3	5	3	3	5	3	3	5	4	4	5	3	4	5	4
Hatched	3	4	3	3	5	3	(b)	3	2	3	4	3	4	4	(a)	3	4	4
Fledged	3	4	3	3	3	3	-	2	2	3	4	3	3	4	-	2	4	4

TABLE 4
Record of thirteen pairs of mixed history

Pair No	Thirteen			Fourteen			Fifteen			Sixteen			Seventeen		
Clutch	1st	2nd	3rd	1st	2nd	3rd	1st	2nd	3rd	1st	2nd	3rd	1st	2nd	3rd
Eggs	1	4	3	2	4	4	3	5	5	4	3	3	4	4	4
Hatched	(b)	3	(a)	(c)	(c)	4	(c)	3	4	(c)	2	(c)	3	1	(a)
Fledged	-	3	-	-	-	2	-	3	4	-	2	-	3	1	-

Pair No	Eighteen			Nineteen			Twenty			Twenty-one			Twenty-two		
Clutch	1st	2nd	3rd	1st	2nd	3rd	1st	2nd	3rd	1st	2nd	3rd	1st	2nd	3rd
Eggs	5	2	3	5	4	3	5	5	3	5	5	4	5	5	4
Hatched	4	(b)	3	1	1	(b)	4	2	(b)	(b)	5	3	(a)	4	(a)
Fledged	4	-	3	1	(b)	-	(d)	2	-	-	5	2	-	4	-

Pair No	Twenty-three			Twenty-four					Twenty-five				
Clutch	1st	2nd	3rd	1st	2nd	3rd	4th	5th	1st	2nd	3rd	4th	5th
Eggs	5	5	5	4	3	0	5	2	4	3	5	3	4
Hatched	5	3	5	(b)	(b)	(b)	(b)	(b)	3	(b)	(b)	(b)	(a)
Fledged	5	(d)	5	→	-	-	-	-	3	-	-	-	-

A comparison of egg production by two-clutch and three-clutch pairs is as follows:

	Six two-clutch pairs	Six three-clutch pairs
Average eggs 1st clutch	4.0	3.3
2nd clutch	4.5	4.8
3rd clutch	–	3.3
All clutches	4.25	3.8
Total eggs laid	51	69
Eggs per pair	8.5	11.5

In the two-clutch pairs the second clutch was equal to or greater than the first clutch. The three-clutch pairs conformed to the general rule that in treble-brooded species the second brood is larger than the first or third.

The thirteen pairs listed in Table 4 show much variation in sequence of clutch size and I think that this is probably due to the disasters which overtook early clutches. I suggest that pairs thirteen, twenty-four and twenty-five were probably by nature three-clutch pairs. Pair thirteen laid one egg of its first clutch before one visit and before the next visit the nest had fallen, but the 4,3 sequence for the next two clutches would indicate conformity with the three-clutch rule. Pairs twenty-four and twenty-five had a difficult time. With pair twenty-four the site was under a rickety wooden bridge over which heavy earth-moving machines passed at intervals and on successive occasions the nest was dislodged by vibration. Pair twenty-five seemed unable to effect secure attachment of the nests to a vertical surface, although a

nest in the same situation the previous year housed three clutches without accident; the presence of a 5-egg clutch in the sequence could indicate that for these two pairs the normal number of clutches would have been three.

I have no knowledge of the history of pair fourteen except for one season. The nest site was a small farm bridge now replaced by a culvert and this has not been used as a nest site.

Pair seventeen site is the same as that used by pair two (two clutches) in the previous season. The poor result from the second clutch may have stimulated the pair to a third laying.

If the three-clutch rule is valid and if the maximum clutch is five eggs it would seem that pairs eighteen to twenty-three were by nature two-clutch pairs stimulated to produce a third clutch by poor results from or disaster to early clutches.

Pairs fifteen and sixteen displayed an unusual departure from normal behaviour. Eggs which fail to hatch may be cast out of the nest during the fledging period or may still be in the nest when the young birds leave, in which case they are usually ejected from the nest before the new clutch is laid. The clean-up of the nest may be a thorough affair, with a new feather lining and sometimes addition of extra mud to the nest rim, or it may be a much more casual effort. Pair fifteen laid a first clutch of three eggs which were covered for the normal incubation period and were still warm on the evening of the fifteenth day, with the parents on a wire near the nest. At the next visit there were eight eggs in the nest, and the bird was still sitting on eight eggs on two subsequent visits. Three chicks hatched, and at some time around hatching date the three original eggs were cast out. At least one egg of the second laying was in the nest until the young birds fledged and when they left it was found on the ground below the nest. The third clutch hatched normally.

Pair sixteen laid four eggs by 21st September and these would normally have hatched by 5th - 7th October. They did not hatch and were still in the nest, though cold, on 24th October. By 31st October three fresh eggs had been laid on top of the original four which by now were dull and discoloured, and the bird was sitting on seven eggs. On 15th November the first chick had hatched and there were still at least five eggs in the nest; a second chick hatched after that inspection and all but one egg of the first clutch had been cast out by November 20th. This too had gone by 3rd December when the two chicks were well grown. After they had departed the nest was cleaned out, new mud added to the rim, and a third clutch of three was laid on a sparse feather lining.

Table 5 compares hatching and fledging success and losses from Tables 2, 3 and 4, and expresses these as a percentage of total eggs laid.

TABLE 5

ex Table	2		3		4		Total	
Eggs laid	51		69		164		284	
Hatched	35	69%	55	80%	63	38%	153	54%
Fledged	34	67%	50	73%	52	31.7%	136	48%
Losses — eggs	16	31%	14	20%	101	61.6%	131	46%
fledglings	1	2%	5	7%	11	6.7%	17	6%
% fledged to hatched		97%		91%		83%		89%

Percentage of fledged to hatched is quite good at 89% but percentage of fledged to eggs is low at 48%; this is of course partly related to the hazards of human interference with nests in accessible positions and of insecure attachment of nests placed on vertical surfaces.

A breakdown of the causes of egg losses is as follows:

	Eggs	% of Losses	% of Total eggs
Lost by nest falling or knocked down	42	32	15
Lost by predation, human or otherwise	27	21	9
Deserted, infertile, did not hatch	62	47	22
	131	100%	46%

Of seventeen nestlings lost one was by nestfall, seven by predation and nine by other causes.

The casualty list would probably be lower in a district where more nests are placed on horizontal surfaces. In unfavourable circumstances it can be considerably higher. In 1964/65 season one large main road bridge was occupied by five pairs. Details of this small colony are not included in Tables 2 - 4. The situation became too confused to permit accurate identification of nest owners and fortunately it is not typical. The colony was subject to periodic persecution by local children and also some predation by sparrows. Five pairs of swallows built in one season a total of seventeen nests and laid forty-seven eggs, but hatched only fourteen chicks, all of which survived to flying stage.

As noted, the figures for percentages hatched and fledged in Table 5 are affected to some extent by predation and nest fall. I have extracted from Tables 2 - 4 figures for nests unaffected by either of those factors, to study results from different sizes of clutch.

Of eleven three-egg clutches (33 eggs) 25 hatched and 25 fledged.
Percentage of fledged to hatched 100
Percentage of fledged to eggs 76

These percentage figures are close to those obtained by summarising all my records of three-egg clutches.

Of nineteen four-egg clutches (76 eggs) 51 hatched and 45 fledged. This gives a fledged/hatched 88% and fledged/eggs 59%, but a truer figure probably emerges from a larger sample:—

Of thirty four-egg clutches (120 eggs) 95 hatched and 88 fledged.
Percentage of fledged to hatched 93
Percentage of fledged to eggs 73

Of eighteen five-egg clutches (90 eggs) 69 hatched and 66 fledged.
Percentage of fledged to hatched 96
Percentage of fledged to eggs 73

These figures are close to those obtained from all my five-egg records.

Nestling mortality was therefore nil in three-egg clutches, 7% in four-egg clutches and 4% in five-egg clutches. Percentage of fledged to eggs was best at 76% in three-egg clutches, and 73% in both four-egg and five-egg clutches.

Survival After Fledging

Twenty-five pairs (Tables 2 - 4) produced 136 flying young, an average of 5.4 flying young per pair. The best of the two-clutch pairs produced nine and the best of the three-clutch pairs ten.

I have no very useful information on survival after fledging. It is not possible to keep track of young birds after they have left the vicinity of the nest. On a number of occasions I have seen a family around the nest bridge a week or longer after hatching, sometimes complete and sometimes less one bird. I have only once found a swallow dead on a road. It is unfortunate that a row of swallows sitting on a wire has an irresistible attraction for a certain type of youth armed with an air gun. Young swallows do not seem to crash into plate glass windows as do young kingfishers, shining cuckoos and some passerines.

Causes of Loss; Predation

As already noted, 32% of losses in Tables 2 - 4 were by nests falling or being knocked down, and 21% by predation. Many nests were knocked down by thoughtless children for no reason except wanton mischief, and in one case four nests under a multiple-nesting bridge had been carefully removed from their position on vertical surfaces by some person, and placed on the ground. Two of them contained eggs. Under one bridge a nest had become detached from its anchorage and someone had found a forked stick with which he propped the nest against the wall in nearly its original position. This first aid was successful and the birds reared their family.

Skegg (1962) mentions a case where a nest had been built under a gap between two bridge planks and was full of road dust which had buried the single egg, and I have seen this happen elsewhere. Use of wool as lining material in the nest can have its pitfalls. On one inspection round we found a young bird, ready to fly, hanging below the nest with one foot firmly entangled in part of the wool lining.

A Hokianga farmer had swallows nesting in an outbuilding and found that their nests were repeatedly predated by rats. Eventually he closed up the building to prevent ingress by the swallows, so that they might seek an alternative building site (R.C.). I have suspected rat predation as a cause of losses at some nest bridges but have as yet no proof. It is also possible that Mynas may bear responsibility for disappearance of chicks from some nests; again I have no proof, but Mynas were in the area and it was difficult to think of any other cause of loss, having regard to the nest situation.

Red-billed Gulls sometimes dispute perches with swallows. Pied Stilts and Dotterels appeared to resent the presence of swallows hunting insects over a stream which spilled out on to a beach (M.J.B.). I have not noticed any antagonism between swallows and any other bird except House Sparrows, which sometimes chase swallows off wire perches and not infrequently interfere with their nests. H. A. Findlay mentions that as early as 1960 he saw straw hanging from swallow nests under a bridge at Kawakawa. Swallows which attempted to nest on a house near Kerikeri were driven off by sparrows. In 1964 season I came across several instances of sparrow interference. On one occasion two sparrows were seen taking feathers from the lining of a nest. A nest from which young swallows had flown was taken over by sparrows and

partially lined with binder twine and some feathers. A newly built swallow nest was appropriated before the swallows used it and similarly lined; another new nest was seen to have loose straw projecting from it and on investigation proved to contain three sparrow eggs. All these instances occurred under one multiple-nesting bridge, and it is interesting to note that in 1965 season there has been no sparrow interference whatever at this bridge, though human predation unfortunately still occurs from time to time. At another bridge there were in a nest four swallow eggs which should have hatched about 31st August; they were seen on August 29th. Inspection of the nest was not possible on 5th September because of flooding. By 13th September, when the chicks (if hatched) would have been about half grown, the parent swallows had completed and lined a second nest and the first nest was empty and had no feather lining. On 27th September it was filled with wool and rubbish and a dead cock sparrow dangled below the nest, one foot entangled in a strand of binder twine.

POPULATION SPREAD

As at 1965, Northland is the main stronghold of swallows in New Zealand. Swallow population is dense in Mangonui and Bay of Islands Counties, increasing in Whangaroa and Hokianga Counties, scattered in Whangarei and Hobson Counties. In Rodney County swallows have bred on the eastern side of Kaipara harbour, and there are sight records from Kaipara South Head. A few birds have been seen around Auckland, and in coastal areas at Firth of Thames and Bay of Plenty. Breeding has been reported from Waikato, Hawkes Bay, Manawatu and Wairarapa, and sightings from Taranaki.

The only reports of breeding in South Island come from Canterbury, but there are recent sight records from Cook Strait Islands, Marlborough, Nelson, West Coast, and a report of sighting from Southland.

The spread of population in the four northern counties is discussed in some detail and reports from other districts are summarised.

Mangonui County

This comprises the long peninsula running from Waipapakauri to Cape Reinga with Ninety Mile Beach on its western side and Rangaunu Bay, Houhora and Parengarenga harbours on the eastern coast, and a smaller peninsula with Lake Ohia at its base and Cape Karikari at its tip, between Rangaunu and Doubtless Bays; at the eastern end of Doubtless Bay is Mangonui harbour. The Awanui-Kaitaia-Ahipara triangle is flat country, separated by a range of hills from Herekino harbour. South of the coast road from Awanui to Mangonui the land rises to the Maungataniwha Range.

In 1958/59 season Michie (1959) reported nesting of two pairs of swallows at the southern end of the large peninsula, one pair at Awanui and one pair at Paparore; in the same year swallows were present at Pukenui (Houhora harbour) and may have nested; they certainly did so in 1959/60 season (A.W.). Michie also reported a nest at Aurere Flat, west of Kaingaroa and near the base of the smaller peninsula. In the following season (1959/60) Ledgard (1960) reported two nests at Tokerau, on Doubtless Bay, and Graham (1960) two nests at Herekino. It seems reasonable to suppose that the present swallow population of Mangonui County is largely if not wholly made up of successive generations descended from these eight pairs.

Establishment of swallows on the main peninsula has been most successful, especially on its southern half. By 1960/61 there were already a number of nests around Pukenui, Raio and Motutangi. Skegg (1962) reported four sites between Paparore and Kaimaumau and his most northerly nest was about two miles north of Houhora; there were reports of sightings from Waihopo (K. Bond) and Paua (D. V. Merton). Nests were reported from near Te Kao in 1962/63, Tangaoke Landing and Te Paki Road in 1964/65. On the west coast there was report of a nest south of Hukatere in 1960 and of sightings at the Bluff in 1962, Scott Point and Cape Reinga (A.W.) in 1964. In December 1965 we found that the four sites reported by Skegg (1962) between Paparore and Kaimaumau were still occupied, plus another four sites on the same stretch of road; twenty-one birds (not flocked) were seen around Kaimaumau. On a by-road south of Waiharara a bridge had one old and three new nests and we saw a flock of twenty-five young birds. On or near the road Motutangi-Ngataki and under Pukenui wharf there were eighteen nests; every farm in this area seems to have swallows nesting under farm bridges or on buildings. Three nests were found between Ngataki and Te Kao; near Te Kao school there were three nests under a bridge around which fourteen birds were flying and perching. Other nests were found at Tangaoke, Te Kao wharf, south of Paua road junction and north of Te Hapua road junction.

In the stretch from Kaingaroa to Mangonui where Aurere and Tokerau nests were recorded in 1958/59 and 1959/60, Skegg recorded in 1961/62 season nests at Kaingaroa, Aurere and Parapara stream. In 1962/63 there was a nest at Lake Ohia and the nesting range extended eastwards to Taipa (L.J.B.). This eastward extension had continued to Cooper's Beach by 1964/65 and to Kohomaru road junction (east of Mangonui) by 1965/66. North of the main road there have been frequent visual records from various parts of the small peninsula, from 1959/60 onwards. At the time of the solar eclipse in May 1965 swallows at Matai Bay were put to flight each time a rocket was launched. No search was made for nests in this area but swallows are undoubtedly breeding. South of the main road swallows have spread inland along roads which follow the course of streams and rivers. In December 1965 there was one nest on a road about a mile south of Kaingaroa, eleven nests at eight sites on the road south of Lake Ohia and two nests on the Parapara road. Taipa river divides to become Paranui stream and Oruru river. There were five nests on Paranui road, and along the valley of the Oruru river and its tributaries we found ten nests, most of them in Peria district where there is a good swallow population and further search would certainly have added more nest sites to the record.

Swallows are numerous in the flat lands in the Awanui-Kaitaia-Ahipara triangle. No detailed search was made in this area, but the total number of nests must be very large; on nine miles of road seventeen nests were found at thirteen main road bridge sites. Swallows have spread along the Awanui River and its tributaries as far as Fairburn and Kaiaka on Te Puhi stream, Pamapuria in Victoria Valley, and south to Takahue; nowhere in great numbers, but widely distributed.

A ridge of hilly forested country lies between Ahipara and Herekino, and it is geographically more convenient to discuss the Herekino swallows along with those of northern Hokianga.

Whangaroa County

Relatively small in total area, with forest in its north-western corner and along much of its southern boundary, Whangaroa county has so far only a limited swallow population. On the east coast there have been since 1963 frequent sightings of swallows at the mouth of Takou River and they probably breed somewhere in this area, but the main concentration is around the southern side of Whangaroa harbour. The first record for this county is by Skegg (1962), who saw three swallows on power lines at Pupuke road junction. In December 1965 we found twenty nests. Most of these were in the lower reaches of streams which flow into Whangaroa harbour (Kaeo area, three nests; Pupuke river, five nests; Waihapa area — west of Waitaruke, eight nests); four nests were well inland on Otangaroa road, up the Wainui River.

Hokianga County (including Herekino — see Mangonui County)

We know that there were two nests at Herekino in 1959/60 season. Present distribution of swallows lends weight to the belief that colonisation of Herekino and Whangape harbours and part of Hokianga harbour may have been accomplished by descendants of these original pairs.

In December 1965 we found two nests on the Ahipara road just north of Herekino and three nests under bridges on the southern side of Herekino harbour; another bridge which was occupied in 1963/64 season was being dismantled and replaced. Awaroa bridge has been used as a nest site for some years. On the main road from Herekino past Awaroa bridge to Panguru turnoff we found eight nests, and seven nests on four miles of Diggers Valley road which then climbs steeply into hilly country; in 1964/65 there was a nest about two miles up the Waiotehue road.

Awaroa river drains into Whangape harbour. There was a nest at Whangape; near Pawarenga, on the southern bank of Rotokakahi river which is the other arm of Whangape harbour, we found six nests in October 1965; the big bridge at Rotokakahi was occupied in 1963/64 season (R.C.) but is not now used. In previous years there have been nests under bridges on Kohe road, which runs westwards from near Rotokakahi to a point further upstream on Awaroa river, and in 1965 two nests were found further inland, north of Runaruna.

The steep broken country of Warawara forest lies between Whangape harbour and the Mitimiti-Panguru road, but birds now nesting at Mitimiti could have come down the coast from Whangape. A few miles further south is the entrance to Hokianga harbour. On its southern side there was a nest near Whirinaki in 1961/62 (M.R.); in December 1965 we found nests at Oue and near Pakanae and birds nested at Waiotemarama (H.R.McK.); across the harbour at Panguru birds have nested since 1963/64 (R.C.).

Further east, Mangamuka and Waihou rivers drain into the upper reaches of Hokianga harbour. Two nests were found near Mangamuka in 1965; there were sightings near Mangamuka bridge in 1963 and 1964 and near Umawera in 1964. West of Mangamuka river birds nested at Kohukohu in 1963/64, at Te Karae in 1964/65, north of Kohukohu and near Motukaraka in 1965/66. There were sightings between Rangiahua and Horeke in 1963; in 1965 we found a nest a mile south of Horeke, five nests on Marangai-Horeke road and two

nests near Rangiahua, one in a site known to have been occupied in the previous season. The Waihou river valley runs eastwards nearly to Okaihau. It seems likely that colonisation of Waihou and Mangamuka valleys may have been by birds which spread from the abundantly populated area round Okaihau and Lake Omapere in Bay of Islands County.

Bay of Islands County

In Bay of Islands as in Mangonui the first record of nesting swallows was in 1958/59 season, when two nests were built at Waiomio (Shanks, 1960). In 1959/60 season birds nested at Kawakawa (Findlay 1960), and Ross (1960) reports two nests at Te Iringa, south of Kaikohe; he also quotes sight records by Mr. Barrett of Old Bay Road, east of Ohaewai, which indicate probable nesting in that area. Mr. Gallagher of Kaikohe tells me that he saw his first swallow while duck shooting at Lake Omapere in May 1958.

It is not difficult to build up a picture of spread which postulates progressive radial dispersal of young birds to find new sites at increasing distances from these original centres.

East of Waiomio the country is hilly and broken with considerable areas of forest, and spread seems to have been in a southerly direction. At Waiomio Shanks (1960) records two nests in 1958/59, three nests in 1959/60; in 1960 winter a flock of seventeen birds was seen. Four nests were occupied in 1960/61 and in that season birds were sighted at Towai and Motatau, both about six miles away in a direct line. In 1962/63 there were six pairs at Waiomio and birds were nesting further south at Akerama, and at Hukerunui, Whakapara and Hikurangi in Whangarei County; there were also nests in the Towai-Maromaku-Motatau area.

Kawakawa birds which nested in 1959/60 may have come from Waiomio or may have been a separate nucleus. Spread from there appears to have been westwards to Moerewa, Otiria and Ngapipito, south-west to Pokapu and Matawaia, northwest to Pakaraka and Oramahoe and north-east to Opua and perhaps to Waitangi. Birds sighted at Karetu and at Waikare, east of Opua, are probably an extension of this group.

Old Bay Road birds probably spread eastwards towards Paihia, westwards to Okaihau and northwards to Kerikeri, where the first nest was recorded in 1960/61 season. In 1963/64 I knew of five nests in Kerikeri district, in 1964/65 eight and in 1965/66 fifteen nests. The birds sighted and thought to be breeding at Takou Bay, on the border of Whangaroa county, were perhaps the present northern limit of this spread; in 1965 five birds were seen on Moturoa island at the mouth of Kerikeri Inlet.

From the progeny of Te Iringa birds may have come the Kaikohe population and perhaps that around Lake Omapere. In any case they did well, for Ross (1962) records a flock of 100 in February 1962. There is good swallow feeding ground at Te Iringa and this flock may have congregated from a wide area; the southern shore of Lake Omapere is only about six miles away. Okaihau lies just north of Lake Omapere and as already mentioned swallows have spread from there down the Waihou valley and also down the Utakura river towards Horeke. From Te Iringa there has also been a southward spread towards Matarau and Three Bridges on the Huehue stream.

Whangarei County

Apart from the southward extension from Waiomio already mentioned I have not explored this area. The most southerly nest I have found was about four miles north of Kamo. I have had a report of nesting near Riponui (K.R.) and of a sighting in August 1964 at Awaroa river between Whangarei and Onerahi (C.W.D.). No other reports have been received, but it is fairly certain that quite a number of nests will be found in the northern half of the county, and perhaps elsewhere, when a search is made.

Hobson County and Kaipara Harbour

North of Dargaville a sighting was reported in September 1963 near Mamaranui (M.R.), and a nest found near Ahikiwi in 1965 was photographed and reported in the local paper. I have been told of nesting at Dargaville, and in 1965 a bird was seen at Tangiteroria, on the Dargaville-Whangarei highway. South of Dargaville there is an unconfirmed report of sighting at Te Kopuru in 1960, and I am told that birds nested under bridges in that area in 1965.

Near Poutu a swallow was seen on 25th October 1963 (M.R.). There was an unconfirmed report of breeding in 1963/64 season; two birds were watched feeding over a swamp on 9th July 1964; in 1964/65 season a pair nested in a small isolated pumphouse and lost two clutches, but may have had later success as a party of five or six birds was seen around the homestead on 3rd April 1965 (M.J.B.).

At Kaipara South Head sightings were reported from 11th - 31st May 1963; the following autumn birds were again present up till 10th April 1964, when three birds were seen (M.A.W.).

Tapora is on the peninsula which lies east of Poutu and across the harbour. Birds were seen on a farm at Tapora from August 1964 (W.D.W.). A Field Study Course was held at Kaipara in January 1965 and during the course Miss Goodwin and Miss McIntyre found three nests (one old, one with one egg, and one just started) under a bridge on Island road, and saw eleven or twelve swallows. In April 1965 two adults were around the same bridge (R.B.S.).

Kaipara harbour and the Wairoa valley are ideal swallow country and a big increase in swallow population may be expected.

Auckland and Adjacent Areas

I have been told that birds were seen at Leigh, on the east coast about 40 miles north of Auckland, about 1963, but have been unable to confirm this.

Single birds were seen in the Waitakere ranges near Auckland in March 1961 (A.O.E., R.B.S.), another bird in Auckland area in October 1963 (R.B.S.) and one at Mangere oxidation ponds on 1st March 1964 (H.R.McK.).

Firth of Thames

Three birds were seen at Miranda in April 1964 (H.R.McK.). The swallows apparently remained in the district. One bird was seen two miles inland on May 2nd (F.C.K.), three were flying over canals and fields and under a bridge on May 19th, one was over Miranda pools on August 14th and there were frequent sightings at or near the pools from 14th September 1964 till 12th October 1965 (H.R.McK.).

Note: On the inset maps distribution of the Welcome Swallow is indicated as follows:—

Solid black — continuous occupation.

Round spots — nest sites in areas of scattered occupation.

Crosses — sightings.

Waikato

During 1963 shooting season swallows were seen three times at Whangamarino creek, the largest number on one occasion being twelve; some were bathing in shallow water and others were hunting over the water for insects. In May 1964 swallows were reported from lakes just north of Waikato river mouth (H.R.McK.). In 1964/65 season birds were seen frequently around a house and a bridge in Whangamarino district, but no nest was found (M.P.D.). In October 1965 R. T. Adams found a breeding pair under a humpback bridge on Waerenga-Island Block road. Further south, between Ohinewai and Lake Waikare, a farmer reported that a number of swallows had been seen perched on willows in May 1965. In October a nest was found, again by R. T. Adams; two pairs were seen in the area in October (H.R.McK., R.B.S.).

Bay of Plenty

Hall (1960) reported a swallow seen hawking over a swamp two miles from Matata in March 1959; it was seen at the same place on subsequent visits, and in November 1959 three birds were seen over another swamp three miles from the original sighting. I have no other information from the district except a note of a possible sighting near Te Puke.

Hawkes Bay

Hankins (1963) describes a nest under a small wooden farm bridge near Waipukurau which had four eggs on 25th November 1962. Two chicks hatched, but the nest later came to grief in a flood. A recent report from Wildlife Branch states that Mr. L. V. Hansen, also of Waipukurau, had a swallow nest on his property in each season

since 1962/63. A flock of about twenty birds was seen at the south end of Lake Hatuma in 1963/64 season. I have no recent estimate of increased population. At Bay View, north of Napier, two birds were seen in the period June - August 1964 (N.B.M.).

Taranaki

Six swallows were seen by M. G. Macdonald and F. C. Kinsky on 11th July 1964 at the mouth of Waiongana river, between New Plymouth and Waitara. Two or three birds are reported to have been seen at the same place by Mr. Brandon in the previous year. In July 1965 a bird was seen at Waiongana river, one at Waiwakaiho river mouth a little further west, and one at New Plymouth airport (M.G.M.).

Manawatu

The first record of swallows in Manawatu was when Miss Ngaire Shailer, Lake Road, Oroua Downs (near Himatangi) wrote to the late Major R. A. Wilson in March 1961 saying that two swallows had been around a cowshed for about a month. Birds are known to have nested in 1962/63 season and there was a newspaper report of a flock of twelve birds seen near Himatangi in May 1963. In 1964 there were records of sightings from Himatangi and Tangimoana, at the mouth of the Rangatikei river, and up to sixteen birds were counted. In 1965 twenty-two birds were counted, mostly in Tangimoana area; birds bred in a hayshed near Lake Omanuka, near the road from Himatangi to Sanson, in 1964/65 season; a number of birds were seen over some of the numerous small lakes between the main road and the coast in December 1965. The total population in this district may be considerable, but they are difficult to count (E.D.).

Wairarapa

R. Cavanagh reported sightings of quite a few swallows around Pirinoa, south of Lake Wairarapa, in 1963. In May 1964 a bird was seen feeding over a lagoon about three miles from Featherston and Mr. Nix of Kahutara found what was probably an old nest that year. In September 1965 a pair was found breeding under a bridge between Featherston and Martinborough (B.D.B.).

Cook Strait Islands

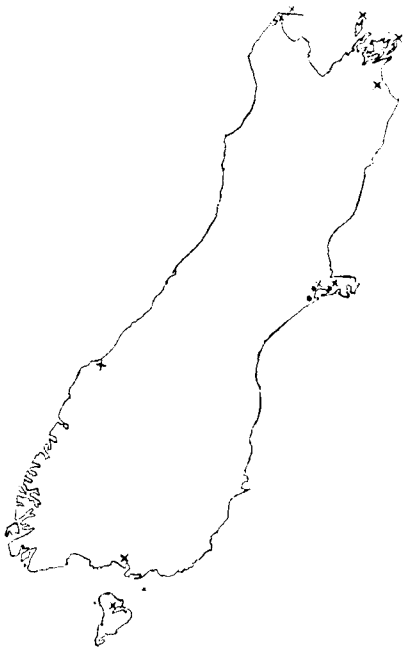
Mrs. Jepson saw two swallows perched on wires on Stephens Island in December 1961 (B.D.B.). On The Brothers A. Wright saw a bird flying and perching on the fence near a hen run on the morning of 16th September 1964; it remained till about 2 p.m. On the previous two days there had been gale force north-west winds and heavy rain; on the 16th the wind was southerly, thirty knots, with cloud down to 900 feet, and there had been rain earlier in the day.

Marlborough

My only record from this area is of two birds seen flying round Smith's Bridge, five miles east of Blenheim, on 24th July 1957 (J. A. Cowie).

Nelson

Heather (1956) records a sighting at the base of Farewell Spit on 25th November 1955. In April 1965 a party of eight birds was reported over the lake at the base of the Spit, and B. D. Bell saw seven birds (probably the same party) twelve miles along the Spit.



Note: On the inset maps distribution of the Welcome Swallow is indicated as follows:—

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Crosses — sightings.

West Coast

A swallow was seen by G. P. Adams at Jackson's Bay, South Westland, on 31st August 1962 (B.D.B.).

Canterbury

Turbott (1965) describes the establishment of swallows as breeding birds around Lake Ellesmere. The first nest, at Lakeside, was in 1961/62 season; birds nested there in 1962/63, perhaps in 1963/64, and in 1964/65 seasons. Swallows were seen at Kaituna in January 1963 and nested at Ataahua in 1963/64 season. Birds which may have been this family were seen four miles from the lake up the Kaituna valley in December 1963. Two birds were seen at North Selwyn Huts in January and one in early February 1964.

Southland

Henderson (1964) describes a bird observed intermittently from November 1963 to March 1964 at Otatara. Editorial comment was that the account and accompanying sketch answered the description of a juvenile Welcome Swallow but "a small patch of creamy yellow on the upper tail coverts or very low on the rump" and the description of the upper parts as "rich velvety brownish black" raises some doubt as to whether the bird was not in fact a Tree Martin.

DISCUSSION

Before 1958 there were in northern New Zealand vast areas of suitable swallow habitat, underpopulated by insect-eating birds. Conditions were ideal for successful colonisation by the 1958 invasion. Population increase has been rapid in the areas of original establishment; there has already been considerable secondary range expansion which will no doubt continue as long as additional ecologically suitable areas are available for occupation.

We know that five pairs bred in 1958/59 at Awanui, Paparore, Aurere and Waiomio. Other pairs may have nested unrecorded at Pukenui, Tokerau, Herekino and in Kaikohe district. It is not possible to estimate the present swallow population of the four northern counties with any degree of accuracy, but in my travels during 1965/66 season I have recorded 270 nests = 270 breeding pairs at the start of that season. The search for nests was undertaken primarily as an index to present distribution, and of necessity was limited to main roads and a proportion of by-roads. I should be very surprised if I recorded more than 25% of the nests which actually existed; if we accept that figure this would give a total of 1080 breeding pairs, about half of these in Mangonui County. I suggest this is not an over-estimate.

There has been a suggestion that the establishment of breeding populations in Waikato, Hawkes Bay, Manawatu, Wairarapa and Canterbury may have been brought about by southward spread of swallows from Northland. As we have seen, there is as yet no population pressure in Northland which cannot be eased by secondary range expansion in that area; I therefore propose an alternative theory to account for these later colonisations.

It may be significant that first sight records for Bay of Islands, Kaipara and Waikato were in May, Firth of Thames in April, Bay of Plenty and Auckland area in March. Taranaki and Marlborough birds were not seen till July but may have been in the area for some time, though unobserved. Presumably the autumn months would be the time of northward movement from Tasmania, and strong westerly winds at that season could give stragglers assisted passage to New Zealand, where some of the survivors remained to breed. We know that swallows appeared at Herekino and Kaitaia about forty years ago, that stragglers were collected at the Auckland Islands in 1943 and at Stewart Island in 1953; a bird was seen at Farewell Spit in 1955, two in Marlborough in 1957, and there were sightings at Bay of Plenty in 1959. It seems to be generally accepted that colonisation of Northland was the result of the successful 1958 invasion. The evidence of straggler records over so long a period and over so wide an area inclines me to the belief that the later colonisations were the result of further successful invasions which occurred over the years subsequent to 1958.

Such information as is available indicates that the population increase and spread of swallows in these southerly areas is proceeding more slowly than was the case in Northland.

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SHORT NOTE

GLOSSY IBISES NEAR CHRISTCHURCH

As far as I am aware, the Glossy Ibis *(Plegadis falcinellus)* has not been previously recorded near Christchurch. I therefore thought my two local records of this species might be of interest.

On 5/9/65 a Glossy Ibis was noticed along the edge of the Heathcote-Avon estuary near the South Brighton School. It was a vigorous feeder. When first seen it was probing with its beak into the saline mud-flats along the water's edge; later it concentrated its activity along the edges of a shallow freshwater stream. In contrast to its ungainly gait, it was a strong flier, with a quick take-off and a rapid wing-beat. There was intermittent gliding.

This ibis was subsequently seen by Miss M. Davis and Alan Wright on 30/9/65; and again by Miss Davis on 12/10/65.

An earlier record is of three Glossy Ibises which I watched feeding together just out from the Sumner lifeboat shed on 7/3/58. At this time there was a widespread drought in Australia; and Frith ex Hoogerwerf recorded a general increase in the wanderings of Australian waterbirds.

REFERENCE

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— G. A. TUNNICLIFFE

EXPERIENCES WITH PARADISE SHELDUCKS

By M. E. W. FITZGERALD

The note on the sexing of Paradise Shelducks *(T. variegata)* (*Notornis* XII, 244) has prompted me to submit the following notes which are based upon personal experiences on the "pumice plateau" lying to the north of Lake Taupo and including Lakes Rotomahana and Rerewhakaitu. They concern numerous birds caught as downies or reared from eggs collected from nests, both wild and tame, and reared to adulthood.

BEHAVIOUR CYCLE

At Christmas-time the birds will be found on Rotomahana and other remote lakes, living in peace with each other. The adults are then in full moult and flightless. A few months later the urge to peg out territories will take a hand and (in at least one well authenticated case) a female will return to her accustomed nesting area accompanied by four or five males. Within a week or two there will be only one male with her. He may be the husband of last year or he may not. If all is well she will use the same nest as previously, but otherwise she may find a new spot more to her liking. If the first clutch meets with failure she will lose no time in laying again in the same vicinity. During November and early December the parents will be seen urging the chicks to use their wings and giving flying lessons. During the last half of December the whole family will repair to the tribal lake to complete the annual cycle.

INDIVIDUAL CHARACTERISTICS

My notes about development of chicks are based upon downies from at least two "wild" sources as well as eggs taken from another source and reared in captivity. There is therefore little likelihood that conclusions are the outcome of individual peculiarities. I formed the opinion that all pairs over a wide region commence to lay on the same day though the date may vary from year to year. This accords with reports that wild shelducks in remote parts of Europe and Asia are farmed by the peasantry according to a plan dictated by their priests. The story is that underground runways are built with an access lid over the nest cavity; after the ducks have laid the first egg the people are allowed to remove one egg per day, always leaving one in the nest, until about eight have been collected; the hens continue to lay until they have a normal clutch to sit on and rear.

MATING AND NESTING INSTINCTS

When the late Colonel Sawer took over control of Auckland Zoo there were Paradise Ducks in a large enclosure which showed no inclination to breed. At the same time several pairs of Egyptian Geese had the free run of the whole park and regularly brought clutches down for caretakers and patrons to feed. At my suggestion the Colonel reversed matters; locking up the geese and disposing of the unwanted surplus and gave two or three pairs of Paradise the free run. Thereafter the Paradise brought forth an annual supply of chicks which were traded with overseas zoos for specimens which Auckland wanted. After his visit to New Zealand, Charles Darwin made special mention of the sex reversal in plumage behaviour of Paradise. European breeders have reported a pronounced tendency for females to go into eclipse. Some

have said that it is the female which selects the partner and that mating in captivity can best be accomplished by placing one female and several males in the same enclosure. My own experience points strongly in that direction.

CONSTANCY

The often expressed opinion that some birds mate for life has been applied to Paradise. I can well believe that there is a tendency for that to happen if there is no interruption to the marital tie. The older the birds are and the longer the relationship lasts the stronger the tie will become. I have seen it with pigeons I once owned. When an old and long married pair lose one, the other will usually fret and fade away, dying of a broken heart. The Paradise hen which was kept under close observation by a pumice land farmer and myself over a period of six or eight years (I am convinced it was always the same hen though not so sure about the male) used always to lay in the same hole in a rocky cliff above a small stream. The hole, no more than three feet long, was about 200 yards from the homestead. Members of the household walked past it almost daily and frequently looked in and spoke to the brooding bird. One season a batch of Indian Runner duck eggs was substituted for those of the Paradise. This was effected by blinding the hen by torchlight and giving her the previously warmed up runner eggs in exchange for her own. The domestic ducks were duly hatched and reared. It was truly ludicrous to see the efforts made by the parents to induce their children to become airborne. In the end they flew away, leaving the Runners behind.

It was inevitable that, as more and more people got to know about this nest someone should rob it in broad daylight and give the sitting hen a bad fright. The male should not have allowed this to happen. It was his duty and invariable habit to be on sentry go at some distance and to give a warning shout whenever strangers were approaching, to enable his mate to slip unobtrusively off the nest and decoy the intruders away. He had not done so for the simple reason that he was dead. His corpse was found later against a wire fence, into which he had probably crashed with fatal results. Now, it so happened that there was a tame pinioned Paradise drake in the homestead garden which was enclosed by wire netting. Within a few days the widow was seen to alight in the garden and to make friends with that male. She soon went to nest again at a new site. This nest was also robbed and again an erring husband had failed in his duty as sentry. The hen was not seen again for several days, but she then came back with about three males in attendance and a little later only one was with her. It is believed that she nested a third time but there is no concrete evidence to support that belief.

SEXING OF CHICKS

You are probably familiar with the contrasting stances of the adults when honking. Females hold the head high and at each clarion call flick the bill up. Males, by contrast, hold the head with bill horizontal and about two inches from the ground while uttering a deep toned grunt. This stance is also used when tame males are charging or threatening their human friend or his dog. On one occasion I had two bantams sharing duty as fosterers for twelve Paradise downies which came from a single clutch. Noticing that some of the

chicks (only a few days old) adopted the head-down stance when moving about, I resorted them, giving one hen six which used the head-down style and they all proved to be males. The other six, reared in a separate enclosure, turned out to be females. First feathers appear on breasts at the age of five or six weeks when females can usually be distinguished by a brownish tinge on their grey breasts — males being pure grey. First head feathers of both sexes are black and here the males frequently have a few random white flecks. In the females a well defined white edge appears against the beak at the age of nine weeks. At eleven weeks this white band has extended to about half way from edge to the eye and a white ring around the eye itself has begun to form.

My series of photos taken at the time shows the female of the pair at eleven weeks with patches of white appearing at random spots and another, when she is six months old, in full adult colours.

INCUBATION

In my experience, the period of incubation is thirty days dated from the time of placing a fresh cold egg under a hen or in an incubator. In nature the first egg of a clutch is left exposed to atmospheric temperatures for nearly twenty-four hours a day. As the days pass the eggs get a feather quilt which conserves the heat gathered from the laying hen and she spends an increasing amount of time on the nest. On laying the pen-ultimate egg she begins, at once, to sit in real earnest. Yet she will lay one more egg (which is never allowed to get cold) the next day (even two days later in the case of Scaup). In the case of the duck tribe, all eggs in the clutch hatch simultaneously. How come? When in doubt about the state of incubation of eggs in a newly discovered nest, the water test is recommended. Place the eggs in still water (in a glass bowl is best). Quite fresh eggs will lie horizontally on the bottom. By the end of the first week (if alive) of incubation, they will touch bottom with big end up and axis at an angle of 45 degrees. At about two weeks they will be perpendicular and tending to leave the bottom. At three weeks they will be breaking surface. During the last week they will float and assume an angle of about 45 degrees with a portion equal to about the size of the original air-space above the surface. Bad eggs will by now often assume an upright position with far too big a section above water level. Within three or four days from chipping each egg will show that the live chick within is moving (be careful to avoid disturbance by your breath or other breeze while observing) and during the final two days the chick will be giving distinct kicks. Be careful not to test once the egg has chipped. Else you may drown the chick.

AN INCIDENT

On one occasion I gave Paradise eggs to a broody Muscovy. The day after they hatched they escaped from their coop and went to a lone Paradise female running loose in our orchard. She promptly adopted them and, in due course, reared them. This female, which had always preferred my company to that of any of the males I had introduced to her, had never mated nor ever laid an egg.

[It is a pleasure to publish these comments from one of our very senior members. Mr. Fitzgerald has often been urged to describe his experiences with New Zealand waterfowl. To quote his own words: "The fact that I served with the 7th N.Z.M.R. in the South African

War will help to carbon-date me and go to show that at least part of my activities belong to that golden era when it was not a crime to rob nests and to rear the chicks as pets. There was the time when I had to show Guthrie-Smith my collection of live Brown Duck to convince him how plentiful they still were from Waipu northwards, where they were being called "Black Teal" and the occasion when I accompanied Edgar Stead to Waipu in order to convince him, too. I also set Stead on the road to breed hybrid Kakariki." — Ed.]

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ITEMS OF SPECIAL INTEREST FROM THE 13th ANNUAL REPORT OF THE NEW ZEALAND BIRD BANDING SCHEME

On 1/4/62 the Dominion Museum, Wellington, assumed full responsibility for the Banding Scheme, which the O.S.N.Z. had initiated in 1946. As the scheme expanded, annual reports were issued. For the sake of continuity the present report is called the thirteenth. It covers 32 pages.

During the year ending 31/3/63, 80 species were banded including the following species not banded before with N.Z. rings:— Fulmar Prion, Wedge-tailed Shearwater, Black Petrel, Cook's Petrel, Gould Petrel, Red-tailed Tropic Bird, Stewart Island Shag, White-faced Heron, Australian Bittern, Antarctic Tern, Yellow-breasted Tit, South Island Robin, Cirl Bunting. The total of species now banded within the N.Z. scheme stands at 114. More details of a Gould Petrel which visited the Brothers Islands, would have been welcome.

The transit of the South Pacific by young Royal Albatrosses is further confirmed by three recoveries from Chile. Two White-capped Mollymawks were reported in South Africa, one more than five years after being banded off Cape Campbell. Six Cape Pigeons banded in Cook Strait were recovered more than six years later from widely scattered localities; and another ringed in August in the Tory Channel whaling station had travelled to Laurie Island, South Orkneys, within two months. Did it return to its breeding station by the E.S.E. or the W.S.W. route, 6000 miles either way? Two Giant Petrels banded as nestlings at Signey Island, South Orkneys, reached New Zealand within six months.

The usual crop of immature Gannets from the Australian coast between Queensland and South Australia is reported.

If we may leave the oceanic wanderers for a moment to mention a very much earth-bound species, remarkable perseverance in homing was shown by a young Weka which tramped 80 miles from Puketapu (H.B.) back to Manutuke (P.B.).

The pattern of gull and tern movements is slowly becoming clearer. While some young Black-backed and Red-billed Gulls wander southwards in their first autumn, there is a marked tendency for Black-billed Gulls to move northwards. Further evidence is provided for the northward movement of young Caspian Terns. Two more White-fronted Terns have been found in New South Wales at the end of their first year.

— R.B.S.

NOTE ON THE SEX RATIO OF THE PARADISE SHELDUCK

By H. J. F. McALLUM

In addition to the sex ratios obtained from shooters' bags and from trapping the Paradise Shelduck, field counts to determine the ratio can be accomplished because of the easily distinguished white head and neck of the female from the black head and neck of the male. An error may be hidden in the counts of the autumn flocks because the juvenile female has a black head and neck similar to that of the male. The white head and neck are attained at about three months of age and as the main breeding season is from September to November, it is considered that the error is small.

The counts were made in the central North Island from November 1960 to November 1962.

METHOD

The flocks were observed from a vantage point through binoculars. The females, the males and the total number were each counted and checked.

Certain areas nearly always held flocks, the numbers of which varied according to the time of the year. These flocks were always recorded. Other flocks were recorded when encountered.

RESULTS

Testing the figures of the large post-moult autumn flocks (March 1961, April 1962) with the X^2 test at the 5% level, shows that the numbers are not significantly different from each other or from the 50:50 percentage ratio. The test shows that the figures for the non-breeding flocks are significantly different amongst themselves, but when summed over the years they are not significantly different from the percentage ratio of the autumn flocks. December has not been included in the non-breeding flocks for there is the possibility that some of the early broods may have joined these flocks.

The X^2 test also shows that the overall percentage ratio of 48.9 : 51.1 does not differ significantly from the 50:50 ratio but is a borderline case.

TABLE 1

Date	No. of Flocks	Range of Percentage Ratio of Males in Flocks	No. Males	No. Females	Total No.	Percentage Ratio
March 1961	19	22.2 - 60.0	1666	1699	3365	49.5 : 50.5
April '62	15	31.0 - 61.8	1022	1048	2070	49.4 : 50.6
July '60	1		42	49	91	46.2 : 53.8
November '60	4	22.5 - 37.0	57	124	181	31.5 : 68.5
September '61	9	9.5 - 82.2	223	181	404	55.2 : 44.8
October '61	4	16.7 - 74.0	70	94	164	42.7 : 57.3
December '61	2	35.0 - 56.6	240	192	432	55.6 : 44.4
May '62	3	31.5 - 80.0	121	238	359	33.7 : 66.3
September '62	8	22.0 - 78.0	46	78	124	37.1 : 62.9
November '62	5	41.7 - 71.8	175	125	300	58.3 : 41.7
		Total:	3662	3828	7490	48.9 : 51.1

BANDED

Date	No. Males	No. Females	Total No.	Percentage Ratio
January 1962	55	76	131	42.0 : 58.0
January 1963	50	50	100	50.0 : 50.0
	105	126	231	45.5 : 54.5

SHOOTERS' BAG

Date	No. Males	No. Females	Total No.	Percentage Ratio
May 1961 to May 1962	135	143	278	48.6 : 51.4

DISCUSSION

As the tertiary sex ratio is close to the 50 male; 50 female, it supports the commonly held view that the Paradise duck is a monogamous species. It also indicates that there is no differential mortality and that all the adults in this area are potential breeders.

The question "why do the non-breeding flocks differ so much in the percentage ratios?" arises. This is difficult to answer with present knowledge but two possibilities are:

(a) During the winter months, perhaps beginning as early as May, a proportion of the non-breeding population may emigrate from the area.

(b) The range of percentage ratios for males suggests that there is an unequal distribution of the sexes. It has been frequently remarked upon by farmers and is recorded by Buller (1888). This unequal distribution and the topography may lead to sampling error in any one trip, but when the figures for the two years are taken it is smoothed out. No satisfactory reason has been found for this biased distribution.

It is considered that the number of birds banded near Taihape is not sufficient to give a reliable percentage ratio figure. It is, however, interesting to note that the ratio resulting from the shooters' bag is very similar to that of the overall percentage ratio.

The results obtained in this study confirm that the Paradise Shelduck is a monogamous species. In contrast to this, Taylor (1944) found a mean ratio of 1 male : 4.2 females in the South African shelduck *(Tadorna cana)* which implies (a) that it is not a monogamous species although Taylor states it appears to be, and (b) that not all of the population is able to breed as there seems to be a large differential mortality in the male. The size of the sample area may be influencing Taylor's figures.

ACKNOWLEDGEMENTS

I wish to thank Mr. S. Roberts for his helpful suggestions and guidance with the statistical tests; and Dr. K. E. Westerskov for helpful discussions.

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BULLER, W. L., 1888: **A history of the birds of New Zealand**, 2nd Edition, London.

TAYLOR, J. SNEYD., 1944: Notes on the South African Shelduck (Casarca cana Gm.). **Ostrich**, Vol. 15, No. 3, p. 189.

SHORT NOTE

AMERICAN WHIMBREL (HUDSONIAN CURLEW) IN FIRTH OF THAMES

(a) The first of March 1964 was a dismal day. Heavy clouds hung low over the Firth of Thames and as with two friends, I approached Miranda, heavy rain set in. For most of the morning visibility was reduced to a few yards in the driving rain, but we were fortunate enough to strike two clear spells in the course of our visit. The first, at the old lime-works, was just long enough for us to pick out two Terek Sandpipers fossicking actively along the flanks of a mob of Wrybill. The second time when the rain lifted briefly, we were moving along the foreshore near Waitakaruru towards Kairito. By this time the tide was well on the ebb. All along the receding tideline waders were scattered including at least six Longbilled Curlews *(N. madagascariensis)* distributed among the Godwits. Some hundreds of yards away to our right a bird jumped up hotly pursued by a Godwit and flew towards us, coming to rest directly ahead, not twenty feet from a Curlew. The bird was obviously a Whimbrel but as it landed no pale markings on the back were apparent. Since my schooldays I always now take particular note of the markings on the back of any Whimbrel which I encounter, hoping to detect a dark lower back and rump without any pale markings, this being the distinctive field characteristic of the Hudsonian Whimbrel *(N. phaeopus hudsonicus)*. This bird would not allow any closer approach than a hundred yards or more before flying. Twice without success I tried to approach closer. Then the rain set in once more, and the Whimbrel disappeared into the gloom, winging its way somewhere in the direction of Miranda, and we retired to the car. In most respects this Whimbrel closely resembled an Eastern Whimbrel *(variegatus)* in size, shape and colouration, but in place of the usual pale back extending up between the wings, this bird displayed a uniformly dark upper surface as it flew away on both occasions when I had attempted to approach it. It was very restless and chose to stay apart from other birds. On Ohiwa Harbour, Bay of Plenty, in 1949, McKenzie also found this sub-species of Whimbrel very wary, reporting (Notornis IV, 20) that "Much weary rowing, our athletic youth being many years past, could almost have convinced us that this wariness was indeed a valuable identification means."

The Whimbrel was reported only once again, on census day, May 17, on the same stretch of coast.

— M. J. HOGG

(b) On 17/5/64 Stewart Payne, my husband, J. A. Brown, our children, Caroline and Mason, and I visited the Kairito shellbank at "Wrybill Reach." Our task was to cover this area for the 1964 winter census of the Kaiaua-Thames coast. The weather was a mixture of sunshine and scattered showers and a sudden squall had given us a brief wetting. Fortunately it had cleared away, enabling us to count the birds, mainly Wrybills *(Anarhynchus frontalis)*, that were present. We had found two well coloured Curlew Sandpipers *(C. ferruginea)* and also two Terek Sandpipers *(Xenus cinereus)*, the bright orange-yellow legs of the latter being reflected in the wet mud as the tide ebbed and they moved out to feed.

Looking back from our position half-way along the shellbank, I noticed a Long-billed Curlew *(N. madagascariensis)* on the mud to the

landward side of the shellbank and about a hundred yards north of us. The bird got up in sudden alarm, giving its distinctive call and we all saw that it was being chased by a smaller bird. The attacker was similar to the Asiatic Whimbrel *(N. phaeopus variegatus)* which is known to us, but this bird was entirely brown on its upper surface and without noticeable barring (B.B.). An excellent view was obtained by all of us as it swept closely past. The flank was creamy fawn (B.B.) and the legs trailed behind the tail (J.A.B.). The bill was long and curved down and the flight rapid and powerful. It gave no call. When later we joined other parties at the census base at Miranda to hand in our tally cards, Mr. H. K. McKenzie, on our evidence, confirmed our identification of the bird as an American Whimbrel or Hudsonian Curlew *(N. phaeopus hudsonicus)*. He stated that it was almost certainly the same bird which had been seen and described a short time before and in the same vicinity by M. J. Hogg.

— BETH BROWN

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NOTICES

REQUESTS FOR INFORMATION

The spectacular spread of the White-faced Heron *(Ardea novaehollandiae)* appears to be continuing. Information on the establishment of new colonies, the size of flocks, changes in local population, should be sent to:— Mrs. A. L. K. Carroll, Wildlife Research, Dept. Internal Affairs, Wellington.

A special study of the New Zealand Thrushes *(Turnagra)*, their discovery, habits, decline, etc., is being made by Mr. D. G. Medway, who would be grateful to receive any information which members may have of unpublished records or out-of-the-way references. His address is: P.O. Box 476, New Plymouth.

FIELD GUIDE

Members may be interested to know that the long-promised "Field Guide to the Birds of New Zealand" has reached the page-proofs stage and should be available within a few months.

LITERATURE AVAILABLE

Back Numbers of Notornis at 5s. each. Large orders for full or part sets at special prices.

Reprints of "Kermadecs Expedition, Nov. 1964," by A. T. Edgar, at 4/6d.

O.S.N.Z. Library Catalogue, 70 pp., at 5s.

Banding Reports, Nos. 8 - 14. 5/- each. (Nos. 1 - 7 are incorporated in early journals). Order from Mrs. H. R. McKenzie, Box 45, Clevedon.

DONATIONS for Year Ending 31/12/65

Cash: McLaren I. G., £2; St. Paul E., Gallop C. P., Parsonson C. F., Broun W. J., Nuttall A., £1; Fagan J. A., Todd A. Wightman G., 10/-; Smaller amounts totalling £1/7/7.

Field Study Courses: Cragg A., £5/12/6; Mackenzie N. B., £2/11/-; Fooks L. E., £2/5/6; McKenzie H. R., £1/7/-.

Photographs: Bell B. D., Blackburn A., Dominion Museum, Flux J. E. C., Harrow G., Merton D. V., Morgan B. and J., Wright A.

Officers' Expenses: Boeson B. E., Beach Patrol, 16/2; Brathwaite D. H., Checklist, 10/2; Miss M. M. Neill, Nest Records, account not kept; Sibson R. B., Editor, account not kept.

Back Numbers of "Notornis," Etc.: Duguid Mrs. F. C., 42; Gittos S., 20; Maning A. H. M., 5; Munro A.J., 50; Southerill E. H., 24; Tunks Miss E., 9.